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THE PRACTICAL TEACHER

ADDRESS PRESENTED TO MR. ALLEN CROFT, Ex-President, N.U.T.

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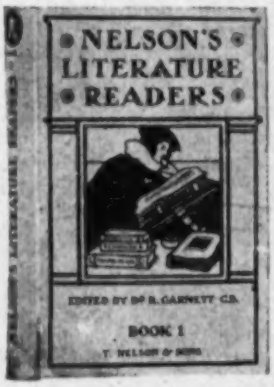

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THE

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EDUCATION IN PARLIAMENT—APRIL–MAY.

THE Second Reading of the London Education Bill presented some very strange features, in a Parliamentary sense uncommon and almost unique. The Bill that upon its First Reading had been belaboured with argument and riddled with ridicule was, everybody knew, to be transformed in Committee into a condition like that of the little old woman whose skirts were trimmed until she didn't know herself. Yet, by Parliamentary form, it was the printed Bill, and not the prospective one, which was to be discussed on the Second Reading. As a matter of fact, however, it was *not* the Bill that got discussed: the Bill got denounced, trounced, and battered; what was discussed was the measure which was later to emerge. By a *tour de force* of dialectic, Mr. Balfour managed to convey that the Bill would be open to the freest amendment in Committee, without at the same time forsaking its principles himself; later on in the debate Mr. Walter Long conveyed the same assurance in a clumsier way. Dr. Macnamara seconded the amendment against the Bill in a fine philippic, and Mr. Yoxall held up to scorn the new practice of talking about an "aerial" Bill and voting on a dead one. Mr. Gray was not fortunate enough to catch the Speaker's eye. On the First Reading Debate he had thrown over his party and announced war to the knife against his leader's Bill. It is not to be wondered at, therefore, that his party whips, in drawing up a list of their speakers to suggest to Mr. Speaker, should leave Mr. Gray's name off the roster. The discussion, however, followed party lines in the main, and the second stage of the Bill was affirmed by a large majority—all the larger because the Irish members voted for the Government and the Bill.

A very remarkable speech came from Mr. T. P. O'Connor, who threw doubts upon the measure from the Roman Catholic point of view. He had been warned, he said, that the Bill of last year, now an Act, would work harm to the schools of his Church as Roman Catholic institutions, and already it was seen that Roman Catholics were not being appointed so numerously on Education Committees of Town and County Councils as they used to be elected on School Boards. Two priests sat on the London School Board now, but he doubted whether they would sit on the London Education Committee, according to the Bill. The House, however, was in no mood to consider the rights and privileges of clerical persons. Indeed, a remarkable feature of the debate was that small reference was made to the polemical and denominational sides of the Bill. All the disputable matters of the Bill of 1902—the departure from the principle of taxation hand in hand with representation; private management of public money; denominational teaching; the appointment of denominational teachers by denominational managers, at the cost of the public almost wholly,—all these were included, by reference to the Act of last year, in the London Education Bill. Yet all these were tacitly avoided in the debate, for the most part; and this may be taken as a sign of grace upon which educationists pure and simple may congratulate education. All the whirl and fury of the No-rate Movement—all the anything but passive declarations of the "Passive Resistance" people—these find no echo in the House of Commons at present, even at a time when the House has on its *menu* again an Education Bill.

It would be unwise, however, to count on a complete exemption from theological disputes in this matter. The Committee stage has to be gone through, and while it waits for other Bills to go ahead, the Passive Resistance movement becomes less passive day by day. We shall hear much of the wrongs of conscience and the flouting of political principle some few days hence, when the detailed debate has begun. None the less, it may safely be said that by attrition, and mere *ennui* of repetition, the members of the House are inclined to let the old wrangling go by with the least possible renewal, and the policy of the teachers in the Act of last year is likely to bear abundant fruit. That policy is now seen to be to ensure equality of educational treatment for all

schools, "provided" and "non-provided;" and then, upon that basis, so to work as to redress political and theological grievances in due course. It is not to the interests of education, indeed, that these subjects of dispute, Parliamentary and local, should continue to disfigure our educational system; and one great result of the Act of last year seems to be a solidarity of teachers, Voluntary and Board, where before there was a perpetual danger of fissure and conflict between them. So far, however, there seem few signs of more solidarity between elementary school teachers and teachers in secondary schools.

There are burning questions of its own, however, existing in the Bill, in the part of it which proposes educational machinery for London. Are the London Borough Councils—these so lately respectabilised and glorified Vestries—to have any share in the machinery of administration? Is the London County Council to be really supreme? Are Borough Councils to appoint and dismiss teachers? Is education in London to be parochialised, with a Lambeth code and a Peckham set of principles? How can the work of administration be performed by County Councillors and Borough Councillors who have already so much other public work to do? Can a composite Authority, not specially elected for the purpose, and the purpose only, manage 20,000 teachers, 2,000 schools, 1,000,000 pupils, and £4,000,000 sterling a year?

The N.U.T say No; the Metropolitan Board Teachers' Association say No; and the "barbarism" "*ad hoc*" sounds in the ear like a war-cry against the Bill. But there is war about it even in the camp of the Government's friends. Some of the London Unionist members of Parliament will not have the Borough Councils touch the schools; others of the same party will not have the power of the London County Council aggrandised in the least. In short, as usual—as always—it is political questions, and theological questions, which are to form the pabulum of debate; and our Lady of Education waits shrinkingly in a corner till the hurly-burly made in her name is over and done.

It is always unwise to prophesy, but I will venture to forecast the upshot of the further stages of the Bill. I think the supremacy of the London County Council will be affirmed and made clear; I think the number of Borough Councillors and co-opted persons on the Education Committee will be reduced; I think the Borough Councillors will be retained on the Committee; I think the managerial powers of the Borough Councils over the schools in their respective areas will be limited and whittled a good deal away. Much of this will have been done in Committee by Whitsuntide, before these vaticinations are published, perhaps.

The great fear of the teachers is that, through too much other work claiming the time of the London County and Borough Councillors who form the Education Committee, the real control of the schools will rest in the hands of co-opted faddists and salaried inspectors; and against that danger there seems very little practicable guard. Yet the teachers' organisations are strong—testimony to that is repeatedly heard in Parliament; they are *too* strong, M.P.'s are beginning to say—and it will be for the teachers' organisations to show their strength at need, in the administrative disputes which may arise after the Bill becomes law. The teachers thus far have hardly shown themselves as wise in counsel over this Bill as they did over the Bill of last year. The real business now is to amend the Bill, not to utter "*ad hoc! ad hoc!*"

Mr. Balfour is said to have sworn a mighty vow that when this Bill is through his ministry shall touch Education no more. That is probably a true statement, in both its branches. "Education" has come to be anything but a "blessed word" with members of Parliament; even the teacher members have had their fill of it of late. In sign of which, during the lull between the Second Reading and the Committee stage, Dr. Macnamara takes a hand in the Parliamentary Golf Handicap, and Mr. Yoxall backs a more famous novelist in his efforts to prevent the name of Carnegie being advertised in the same Henley Street as the name of Shakespeare at Stratford-on-Avon. And so, with monotony flecked with brief and characteristic change, the Parliamentary struggle for better education in South Britain goes on.

BY MANY HANDS.

"Quot homines, tot sententiæ."

ONE cannot escape from the Education Act, not even when one turns one's eyes abroad and picks up the foreign journals. The *Pädagogische Reform* of April 8 gives itself up to one long article, in which Mr. G. W. Sleight, a well-known Hackney teacher, explains the situation to our German brethren with an easy command of the tongue of the Fatherland that will awaken a little thrill of envy in some breasts. He ends up a long and well-informed article with a fervent hope for the speedy dawn of the day when the national education will be purely secular—the only way of putting an end to the sempiternal religious difficulty.

The Omnipresent Subject.

Even longer and more exhaustive are the article and analysis consecrated by the *Revue Pédagogique* to the same Act. The writer, M. A. Guillaume, has evidently been at some pains to make himself master of his subject. He has studied the history of the questions raised by the Act as far back as was necessary; he has mastered the details of what, for want of a better name, we must call the English "system" of primary education; pursued inquiry into all the various departments of activity affected by the new Act—educational, religious, financial, administrative—and followed up the debates in and out of Parliament. It is a triumph of accuracy, this article—a veritable triumph.

THIS is no mean praise for the writer. Unlike the German article which was written by an Englishman, this article is written by a Frenchman! For the full force of that note of admiration, just think for one moment of the wealth of pitfalls that English spreads before the feet of the unwary Gaul. The bare language supplies enough,

Bravo! M. Guillaume.

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and to them add the difficulties which bristle around our education and our names. Yet all is correct—Cockerton and Cowper-Temple, Kenyon-Slaney and the N.U.T. We think you will agree that the note of admiration was well deserved. For ourselves, we congratulate the *Revue Pédagogique* on an article so clear, full, and accurate. A lucid analysis of the Act as it appears to the writer in intention and in performance closes the article. The *pros* and *cons* are set out with rigid impartiality, for while none of the opponents of the Act have condemned its clauses with greater warmth than our critic *d'outre-Manche*, none of those who blessed it have done so with more earnestness than he. Often, indeed, they have blessed with less discrimination; he is too clear-headed to bless without showing a very good reason for the benediction. The two articles are a striking testimony to the interest stirred among our Continental brethren by our tribulations.

THE age is one of solidarity among fellow-workers. Here is another example culled from a contemporary. An educational association has been formed at Vichy with a view to helping the educationists who go there during the season. The association will try to obtain reductions in price for the water-treatment, at the hotels, the casino, with the chemists, merchants, and tradespeople, in favour of teachers; it will organise excursions; and in a general way will provide its members with all useful information for their stay at Vichy. All this for the modest subscription of one franc. The intention is an admirable one, and illustrates once more what can be done with a little forethought and a good deal of solidarity. But a selfish thought strikes us. English teachers travel far when on holiday thoughts intent, and Vichy is no stranger to many of them. We wonder whether the *Association des Universitaires de Vichy* would extend their privileges to English comrades? The suggestion may appeal to some teacher who is casting his eyes Francewards for the summer. For him we append the address of the association—*à l'école primaire supérieure, boulevard Carnot, à Vichy.*

For those going to Vichy.

CHINA has outstripped us! She passed her new Education Bill in 1901, or, at least, as Bills are not passed in the Flowery Land, she issued edicts. Happy China! where an edict settles the fate of a thing straight off, and the Celestial gasbags are not allowed even to leak! We have heard something in these latter days of "four-line" Bills in England, but four edicts in far-off Cathay settled the business of education as it referred to examinations for civil officials or for officers, to the education of Chinamen abroad, or to the organisation of Chinese schools, all at one clean stroke. To borrow a Japanese phrase, there is a "happy dispatch" in this method of settling all your educational squabbles and muddles, and arrangements and derangements, that makes one yearn longingly for a few edicts at home. The process is so simple and yet so effective, so thorough and yet so quiet, so appallingly but seductively quiet. But laying envy aside for the moment, we return to our point that China has put her educational house in order a year ahead of the Western barbarians.

China Awakes.

AND what is more astonishing, she has made innovations. Those last two edicts are significant. The young Chinaman is to profit by the education of the "foreign devils;" nay more, he is to go among them and seek it. The viceroys are to select and maintain a number of young Celestials who are to study the languages and civilisations of the foreigner. The significance of that fact is hard to blink. Is the fateful moment arriving when China, like a much-trodden worm, is about to turn, and study the ways and the knowledge of the "foreign devils" with a view to using them against their owners? The question may seem exaggerated, but there is ground behind it, for five hundred young Chinese have been sent to the empire of the Mikado, and others are to be installed in one of the biggest *lycées* of Paris. And if the fourth edict has any connection with its predecessor, there is more than meets the eye in the promulgation of these four laws; for No. 4 provides that universities shall be founded in all the provincial capitals, *lycées* in all the large and colleges in all the small towns, and that the number of primary schools shall be largely increased.

Celestial Students.

IF this elaborate provision of internal facilities has any connection with the seeking of education abroad by Chinamen, who, until the other day, were execrating the foreigner and all his belongings—if this be so, then perhaps the waking up of the Celestial Empire is at hand. What that waking up will be the future only can show. But a professor at the Nanyang College at Shanghai declares that the educational reform is a *fact*, that progress will be slow but sure, and that these travelling students will be fitted on their return with official posts suited to their capacity. And in all this he sees English influence, so marked that five days a week are given, he says, in some Pekin schools to English subjects, and all these studies are conducted in English. Wonders will never cease. It seems only the other day we were thrilled at the story of the siege of the Legations, and to-day we read that English influence has brought about an educational reform in the land of the five-toed dragon—a reform of so far-reaching a nature that heaven alone knows what will be the result.

To what End?

THE *Practical Teacher* again comes in for genial notice by the *Revue Pédagogique* in its analysis of the world's pedagogical journals. The numbers for January and March are analysed, and compendious paragraphs on the most interesting articles are given. The analysis of Mr. Liberty Tadd's method and book, completed in the same number, also contains reference to the discussions that passed in the *Practical Teacher* on the work and theories of the Philadelphian. M. Baudrillard is as attentive a reader of the *Practical Teacher* as M. Guillaume.

Friendly Notice.

N.U.T. NOTES.

WHEN Mr. B. South—whose *sobriquet*, the "sunny South" is singularly felicitous and *àpropos*—temporarily took the chair at the first meeting of the newly-elected Council, one observed with pleasure that he was surrounded by nearly all the old familiar faces. Messrs. Hardy and Weston, who were defeated at the polls in hard-fought contests, were two of the most useful workers for the funds; and to these gentlemen—as well as to Mr. T. F. Bowers, the late chairman of the Relief and Loans Committee—the Council, unanimously and with acclama-

The New "B. and O." Council.

tion, ordered letters of thanks to be sent, in recognition of their brilliant and valuable services. Mr. Bowers has been in somewhat delicate health for some months, and at his own request was not re-elected to represent the Executive on the Central Council. In his place came Mr. A. S. Caudle, one of the ablest and wittiest members of the Executive. (I often regretted, during the past twelve months, that we heard so little from Mr. Caudle, and so much from the sufferers from that terrible disease, *cacoëthes loquendi*; but let that pass!) The Council adhered to precedent in choosing as its chairman for the year the former vice-chairman, Mr. C. J. Chase, whose personal qualities and splendid record qualify him thoroughly for his onerous and honourable position. An interesting contest for the vice-chairmanship between Mr. T. G. West and Mr. Weston resulted in the victory of the former gentleman by eighteen votes to ten. Mr. West's phenomenally successful labours in the chair of the Organisation Committee fully entitled him to the distinction; whilst a similar plea was urged on behalf of Mr. Weston, who had served with credit and *éclat* as chairman of the Finance and General Purposes Committee. The new officers of the Council's chief standing committees I subjoin :—

Committee.	Chairman.	Vice-Chairman.
1. Finance and General Purposes	Mr. C. W. Hole.	Mr. A. Tutt.
2. Relief and Loans	Mr. J. Hodge.	Mr. T. R. Rand.
3. Organisation	Mr. F. F. Wheeler.	Mr. Mennie.

That the Council's work in 1903 will be even more successful than of yore will be every one's fervent hope and prayer.

* * *

The New Executive.

WITH the exception of Dr. Macnamara, M.P., and Mr. Marshall Jackman—both taking a well-earned rest after their arduous labours in connection with the London Education Bill—the new Executive forgathered in full strength on the first Saturday in May. An interesting discussion occurred at the outset as to whether the standing committees should elect their own chairmen and vice-chairmen, or whether these should be chosen by the Executive, as in previous years. My own view is that whichever method of selection prevailed the result would be the same, and, on the whole, I was glad to see the adherence to the old custom. The officials for 1903–4 are as follows :—

Name of Committee.	Chairman.	Vice-Chairman.
1. Education	Mr. A. R. Pickles, B.A.	Miss Cleghorn.
2. Law	*Mr. John.	*Mr. Hurden.
3. Tenure	*Mr. T. H. Jones.	*Mr. T. P. Sykes.
4. Finance, Press, and General Purposes	*Mr. Peaker.	*Mr. Blackburn.
5. Parliamentary	*Mr. Jackman.	*Mr. Cullum.
6. Organisation	*Mr. Rankilor.	*Mr. Caudle.
7. Examinations Brd.	*Mr. T. F. Bowers, B.A.	Mr. Boulter.

(* Held a similar position last year.)

All the chairmen were elected by a unanimous vote. Mr. Pickles had been so admirable an understudy to Mr. Sharples that, when the latter became vice-president, it was a moral certainty that Mr. Pickles would step into his shoes, and he is emphatically "the right man in the right place." Miss Cleghorn leaves the vice-chair of the Examinations Board for that of the Education Committee, and this again is a thoroughly sound as well as popular appointment. Her former position was, after three ballots, allotted to Mr. J. T. Boulter, a "silent member" of the Executive with a perfect passion for hard work. Some little objection was evinced against the choice, year after year, of the same men for the offices of trust; but, after all, what the Executive had to consider was *how to secure the best results*, and, in my humble judgment, a more capable and efficient set of chairmen and vice-chairmen has never been seen at Russell Square than the fourteen whose names are printed above.

* * *

The Executive Election.

ONE of the most important of the purely "domestic" resolutions passed at Buxton was the following :—"That it be an instruction to the Executive to prepare a scheme for the triennial election of members of the Executive, adaptable to the altered conditions of educational administration and the consequent reorganisation of the Union; that the scheme be sent down to the associations before the end of December for discussion; and that the scheme of the Executive do not provide for more than thirty-six members." Conference had become alarmed, and rightly so, at the continued automatic increase in the size of the Executive, and the consequent augmentation of the amount annually expended on travelling expenses. Only a Fortunatus's purse would have eventually sufficed for these latter, and I, for one, am heartily glad that a reduction in numbers is in sight. (Whether the "thirty-six members" mentioned in the resolution is inclusive of the officers of the Union is not quite clear, but on this point the President will doubtless decide.) After attempts had been made to refer the matter to both Finance and Organisation Committees, it was decided that a committee of the whole Executive should meet on Saturday, June 20th, at 2.15 p.m. to determine the *principles* on which the scheme should be based. There is quite a strong feeling existent, both within and without the Executive Board, that the present system of three (or four) membered electoral districts has not proved a success; and certainly the rejection of Messrs. Waddington and Wild in successive years lends colour to the contention. My own view, formed after much thought and deliberation, is that the old system, whereby the whole Executive were elected by the whole of the country, produced stronger and more capable men than the present system has done. If a reversion to the discarded system is not possible, then I trust the Executive will consider the advisability of recommending *two* districts—1, London; 2, Provincial. If these are too few, then perhaps three or four districts, returning twelve or nine members each, will be acceptable. Of this I am convinced, the larger the areas are, the better will be the men willing to share the responsibilities of the Union's government.

* * *

"Triennial," not "Annual."

WHATEVER differences of opinion prevail as to the *method* of electing the Executive, there seems to be absolute unanimity as to the desirability of substituting triennial for annual elections. My former colleague in the representation of the North Midlands, Mr. George Baddeley, in perhaps the most broadly humorous speech of Conference week, showed how comparatively useless were the members of the Executive in their first year at Russell Square. And certainly it does take some considerable time for the esurient neophyte to become accustomed to the ways in which the Executive transacts its business. Further, the expense and worry incidental to a system of yearly elections had become

almost intolerable; and altogether, from the point of view both of the Union and the Executive member, nothing but good can accrue from a lengthening of the term of years for which the future Executive will be elected.

IT is quite "Lombard Street to an orange" that the next Vice-President of the N.U.T. will be Mr. T. H. Jones, the defeated candidate at Easter. Nevertheless,

New "V.-P." Candidates.

during the next few months other gentlemen will doubtless be found flying a kind of *ballon d'essai* to test the measure of support they are likely to receive in a serious contest for the highest honours the Union can bestow. Mr. T. P. Sykes, of Bradford, has already been unanimously nominated by his own association for the post, and with Mr. Jones out of the field his claims will be strong. It is freely rumoured that a second Yorkshire gentleman, Mr. Peaker of Leeds, will also enter the lists, and his claims are even stronger than those of Mr. Sykes. Mr. Peaker labours under the obvious disadvantage of being no longer actually engaged in school—a factor to count with some people—yet he has rendered magnificent service, not only to the Leeds teachers, but to the Union generally during the past dozen years. Lastly, Mr. C. W. Hole of Hackney, a man of many parts and excellences, is bound to be nominated, and well he deserves the distinction. I can only hope that after the preliminary canter Mr. Jones will be allowed to "walk over," and then the V.-P. aspirants can, next year, all start from the same mark.

IT must, I take it, be regarded as a symptom of healthy, living, active Unionism that certain subjects crop up at Conference with unremitting regularity. One of these

The Organ of the Union.

is the agreement between the N.U.T. and the proprietors of the *Schoolmaster*, which has still some half-dozen years to run. The connection has undoubtedly been highly beneficial to both parties. At the same time, popular opinion inclines strongly to the view that the *Schoolmaster* proprietors have secured more than a *quid pro quo* for the advantages they offer to the Union. At Buxton, Conference declared, with less than ten dissentients, that "if the organ of the Union is to secure the confidence of the members of the Union, it must become the sole property of the National Union of Teachers." The only way to effect this is, of course, to buy up the company's shares, a project which presents inherent difficulties. Conference further declared that, failing the securing of the *Schoolmaster* as the Union's sole property, "the agreement with the proprietors of the *Schoolmaster* be terminated at the earliest possible moment, with a view to the establishment of an organ by the Executive." So far as I understand the situation, the only method of terminating the agreement is for the Union to pay damages for breach of contract, a procedure adopted almost every day in business enterprises, but which would be likely to cost the Union many thousands of pounds. There is no necessity for exuberant gratitude in this matter, yet it must not be entirely forgotten that the *Schoolmaster* has been the means, either direct or indirect, of obtaining many of the educational and professional reforms for which the Union has striven during the past thirty years. The *Schoolmaster* has a position and a prestige which no organ established by the Executive could possess for a long series of years, and in the negotiations to be conducted forthwith the Executive will not lose sight of this fact. At the same time, the directors of the *Schoolmaster* will do well to realise that the Union is in earnest, and that in any future agreement "the reciprocity must not be all on one side."

A. C.

Next Month:

NOTES FOR THE HOLIDAYS.

NOTES FROM THE NORTH.

IN the discussions on the Employment of Children Bill an amendment was moved on Clause 7 to omit Scotland from its operations, but a compromise was

Employment of Children Bill.

arranged. It was agreed, on a division, that in Sections 1 and 3 the local authority should mean the School Board. Section 1 provides for the framing of a code, which will prescribe the age below which employment is illegal, and the number of daily and weekly hours beyond which young persons are not to work. Section 3 sets out a number of restrictions that may be placed on juvenile labour; as, for example, in the sub-section which declares that a child shall not be employed to lift, carry, or move anything so heavy as to be likely to cause injury to the child. In Section 2, which seeks to establish by-laws to regulate street trading by young persons, and to prohibit it altogether in the case of girls, the local authority is to be the County or Town Councils. The following new sub-section was, on the motion of a Scottish member, added—namely, "Nothing in this Act shall affect the power of the School Board to grant exemptions in certain employments, as provided by Sub-section 3 of Section 7 of the Education (Scotland) Act, 1878, and the expression 'this Act' in the sub-section shall be deemed to include the Employment of Children Act, 1903."

IN the House of Commons the Lord-Advocate for Scotland intimated that the Scotch Education Department were taking steps, along with the English Board,

Physical Education.

to nominate a joint-committee to give effect to the recommendation to prepare a model course containing exercises adapted to the requirements of the differently situated schools and the different ages and sexes and conditions of health of the children of Scotland. It is expected that four members will be chosen by the Scotch Department, and that these will include an urban schoolmaster, a rural teacher, a medical practitioner, and a prominent official of the Department. It is to be hoped that the obnoxious part of the scheme now foisted on England will find no place in Scottish education. Teachers will look with jealous eyes at the work of this committee.

IT is not often that the Scotch Education Department comes into conflict with the opinions of its officials. But it would seem as if in the test to be applied for the

Qualifying Examinations.

passing of the qualifying examination there was some divergence of opinion between the Department and some of the inspectors. In a recent letter Sir Henry Craik has said that the standard for the qualifying examination is to be no lower than the standard hitherto required for the Merit Certificate. To those who are practically engaged in teaching, this is tantamount to saying that in future there will be no supplementary courses. At pres-

ent the Merit Certificate is usually taken by children over 13, and we venture to say that the average age is 13½ years. This means that scholars will only take the supplementary courses for six months, and what they can take of the finely-elaborated schemes of Circular 374 in that time we at present fail to see. Perhaps, however, the question of grants has been raised by the Treasury; and the letter of Sir Henry Craik is the result. It looks like this, at all events. It would have been far better if, as rumour had it, the whole situation raised by Circular 374 and Article 29 of the Code had been referred back for consideration until the issue of the Code of 1904.

* * *

Dr. Stewart, H.M.I., on Pupil Teachers.

IN his recently issued report, Dr. Stewart, H.M. Chief Inspector, has some very severe strictures to pass on the pupil-teacher system. He has, of course, special reference to Edinburgh, where the modern device of creating centres at which the pupil teachers prosecute their literary studies under the direction of specially qualified experts has not been adopted. He finds, as the result of inquiries recently instituted, that it is no uncommon thing for pupil teachers to begin work at school as pupils at 8.30 a.m., and to spend the day, up to 3.30 p.m. or so, as pupils or teachers in turn. Some of them attend evening classes thereafter, and they tell him that they require five hours at least for home preparation. He characterises the system as cruel, and is not surprised that they make so poor a show. He suggests that the pupil-teacher system which, borrowed from Holland, "has now been discarded by the whole of Europe except Britain and some of the poorer villages of Russia," might well be dropped to make room for a more excellent way. As showing what system Dr. Stewart would favour, he quotes a paragraph from Dr. Alexander Morgan's Report to the Board of Education, vol. viii.: "There are no pupil teachers in Switzerland. The candidates for admission to the Swiss Training Colleges get their preparatory education, as a rule, in a primary school, and thereafter for two or three years in a higher primary school; in connection with which, it should, however, be mentioned that more and more of the colleges are requiring that the entrants shall have spent at least two or three years in a Sekundarschule."

* * *

E.I.S. Doings.

THE Institute has recently been giving, through its Ladies' Committee, much attention to the proper construction of infant classrooms. Several resolutions regarding this matter have been submitted to the Executive for consideration. The most important of these are—(1) The infant department should have no large room, but should consist of a series of rooms so constructed that two or more of them can be converted into one large room if required. (2) The rooms should be (*a*) situated on the ground-floor, having a sunny exposure; (*b*) nearly square, and of the proper size to accommodate no greater number of pupils than that fixed by the Code; (*c*) constructed so as to allow ten square feet of floor-space to each pupil. (3) The drill hall should not be the well of the school, and should be situated where it will not interfere with the work of the classes. This subject is receiving much attention from the branches, and it is to be hoped that some of the proposals will find a place in the Building Rules of the Department. It is a matter of open secret that many of the school architects are not moved very much by educational considerations.

More Liberty to the Teacher.

IN connection with the supplementary courses a very important memorandum, dated 1st May, has been issued. The same stress as formerly is not to be laid on the observance of a minutely detailed time-table. It is recognised that the construction of a proper time-table will always be an important aid to the teacher in his work; but, provided a proper balance is observed between the main subjects of instruction, it is not necessary to specify regularly recurring periods for each division and sub-division. Again, the sub-divisions may be regarded as interchangeable, to be taken at such times and in such proportions as will best conduce to progress in the main subject.

R. G.

THE PUBLISHERS' EXHIBITION AT BUXTON.

SUCH was the magnitude of the exhibition this year that it was impossible to see all at one visit. We gave the impressions of our "first visit of inspection"—or shall we say "examination"?—last month; but on discussing the matter with friends at Buxton, there was such a repeated cry of "Did you see this?" and "Did you notice that?" that we were forced to the conclusion that we had not seen half, and that another visit was absolutely necessary. We had set out on our first visit with the firm resolve to do the thing systematically; but that was impossible, for the attraction of some well-displayed exhibits, or the allurements of friends, quite upset the prearranged order. And this was not all; for, as we said last time, the publishers monopolised the approaches to the Conference hall, and the furniture and musical instruments were relegated to the Town Hall, and among the latter we discovered that the EDUCATIONAL MUSICAL INSTRUMENT COMPANY had modestly retired to the room on the left at the top of the entrance steps, and was thus overlooked on the occasion of our first visit. However, if they lost somewhat in the matter of publicity, they perhaps gained by having their instruments together in that room, where their good qualities could be tested. We were specially struck with a very fine instrument in oak, the tone of which was sonorous and mellow, and the construction especially strong—qualities which are essential in a school piano. There were also three instruments of superior finish and quality for drawing-room use. In every instance the firm was offering remarkable value for the price asked.

In following the course round the walls of the exhibition, one passed the collection of CHARLES AND DIBLE, for it stood out in a somewhat isolated position. We were glad to visit it, and to note the very useful series of books for drawing—both line drawing and brushwork. The books and cards were drawn up on a sound system, which combined drawing and nature study. A book by Miss J. Mackenzie gave a "Nature Programme," round which the other subjects might be made to cluster.

One neatly-arranged stall caught the eye because it differed from the others in the uniformity of the books displayed on it, and that was the one belonging to the UNIVERSITY TUTORIAL PRESS. The uniformity of cover of the works here shown is emblematical of the uniformity of excellence of their contents.

MESSRS. BLACKIE AND SON had a very large and varied collection of scholastic works on view, most of which are well known to and appreciated by the teaching profession. We had not, however, personally made the acquaintance of their *Standard Shilling Dictionary* before, and were perfectly astounded to think that it was possible to produce such a masterly work for such a low price. This firm is also well up-to-date in the matter of brush drawing, the sets of brush-drawing sheets and brush-drawing cards forming quite a feature. The book on the subject by Mr. Nicol is one of the best for teachers taking this subject. Their concentrically arranged *Complete History Readers* are both well written and splendidly illustrated.

Not far off was the exhibit of MESSRS. CASSELL AND CO., which included many excellent works on technical subjects. A book that attracted marked attention was the revised French dictionary. The new *Union Jack Readers* were introduced by the attractive little book which forms Part I. of the series.

MESSRS. G. BELL AND SONS displayed some remarkably effective school decorations in the form of the *Fitzroy Pictures*, a series of historical cartoons. The *History Readers* and *Illustrated Classics* show that this firm provides for both elementary and secondary schools, and the *Miniature Series of Artists* should be procured by all teachers with a fondness for great art.

Another firm that showed some good historical pictures was that of ARNOLD, Leeds, whose trade mark A.L. is so well known. Here were also exhibited beautiful "View Cards" for rewards, nicely mounted insects, etc., for object lessons, and an unrivalled display of material for Infant Schools.

When one stands in front of a collection like that of MESSRS. CHAMBERS, one forgets that the object of the visit is to report upon school books and apparatus for elementary schools, and although the works of that class here displayed show masterly care in their production, yet one plunges into the numerous works which are more in accord with one's own taste. The *Twentieth Century Dictionary* stands unrivalled in all points; and the student of literature will be interested to know that the *Cyclopædia of English Literature* with which the name of this firm is so well associated has been revised, and appears in three volumes instead of two.

No description of the exhibition would be complete without brief reference to the beautiful floral designs and illustrations of nature lessons produced by MESSRS. BURNS AND OATES.

ing Arthur findeth the sword Excalibur.
He leadeth his host to battle against the Heathen.
He refuseth to pay tribute to the Roman lords.
ational Union of Teachers.
At the Thirty-fourth Annual Conference held in Buxton on April
the following Resolution was unanimously adopted:
That the best thanks of this Conference be, and they are hereby
tendered to
MR ALLEN CROFT,
for his valuable services to the Union during the past two years as Vice-President
and President; and that a copy of this Resolution be inscribed on Vellum and presented to Mr. Croft
as a memento of his years of Office. The Executive desire to add their testimony to the untiring energy and
devotion to the interests of Teachers shewn at all times by Mr. Croft, but particularly during his years of
office as Vice-President and President.

ADDRESS PRESENTED TO MR. ALLEN CROFT, EX-PRESIDENT, N.U.T.

THE address presented to Mr. Croft, retiring President of the N.U.T. at Buxton, is worthy of reproduction in these columns, not only because of its novel and allegorical form, but because it displays an amount of artistry that is usually foreign to such productions. Mr. J. Blake Hadlow, the artist, has figured our friend Mr. Croft as King Arthur. The Knights of the Round Table, we presume, are his fellow-members of the Executive. In the first panel Arthur finds Excalibur, the Sword of the Union, and is thus counselled by Merlin (an ancient member of the Executive), "Take thou and strike! the time to cast away is yet far off." The "passing of Arthur" (at the end of his year of office) is typified by the "arm clothed in white samite" shown in the background. The second panel exhibits Arthur warring against the heathen—to wit, the hide-bound official, the obscurantist, the parsimonious educationist, the faddist, the tyrannical manager, and so forth. The third panel represents Arthur as refusing to pay tribute to the Roman lords. Possibly this typifies the steadfastness and stern moral courage of the retiring President in his opposition to national or local authorities when they are set, as sometimes happens, upon courses inimical to the welfare of teacher and taught. This, we take it, is the particular interpretation of the Arthurian legend as applied to the N.U.T. Generally, we may regard Excalibur as Education, a potent brand with which to beat down the forces of national selfishness, ignorance, and sin. The battles to be waged are many and sore; equally to be feared are the wiles of those who would crib, cabin, and confine the education of the people to subserve certain ends of their own. Various other interpretations might be given, but this is not a prize competition, and we forbear. Seriously, all concerned in this very interesting and highly artistic production are to be cordially congratulated.

BRITISH CHILD-STUDY ASSOCIATION.

THE annual conference of this body was held in Edinburgh on 10th May. The proceedings opened with a reception of delegates and friends by the Master of the Merchant Company and his assistants. A company of some 150 ladies and gentlemen attended, among whom were Dr. and Mrs. Langdon-Down, Mr. Holman, H.M.I., Miss Hale, Edge Hill Training College, and numerous professors, inspectors, and teachers associated with the Scottish capital.

After the reception, the company settled itself down to hear the inaugural address from Dr. Clouston, the great specialist on mental diseases. His subject was "Some Medical Aspects of Child Study." Child study, he said, sounded a fascinatingly simple subject, but a moment's thought by any one who had even the rudiments of the modern scientific spirit showed that it was one of the most difficult questions to which the human mind could direct its attention. Psychology, physiology, pathology, evolution, hygiene, medicine, educational science, must all be called in to elucidate its problems. Dr. Clouston thereafter devoted his remarks to such matters as child study and the brain, the structure of the brain and its functions, brain pathology, brain development, and the pathological aspects of child study. In conclusion, he said it seemed to him that the medical aspect of child study would suggest to the educationist child student the following considerations among many others to be always kept well in view:—Every fact in child life was related to and dependent upon the brain machinery and its workings; the development of the brain followed definite laws, that might be modified by environment, but which would not be essentially altered thereby; faculty and capacity arose in a certain order and came slowly to maturity; the various epochs of development should be taken into account in any scientific process of education; the great object of education should be to help in the development of every organ and faculty, bodily and mental, up to the point of which they are safely capable, and in relation to each other; the more accurate study of the rise, progress, and relation to each other of certain faculties and facts that had or might be made to have a high value in the education process; certain risks in education from bad family heredity should be known to the teacher.

On the motion of Dr. Langdon-Down, a vote of thanks was accorded to Dr. Clouston; and the thanks of the association were also conveyed to the Merchant Company for the use of their buildings, on the motion of Miss Walker, Edinburgh.

On Saturday morning the Conference met, under the presidency of Dr. Langdon-Down, to discuss the question of "Adolescence from Various Points of View." Professor J. Arthur Thomson, M.A., Aberdeen University, first discussed the question from the biologist point of view; Miss Louch, of Cheltenham Ladies' College, spoke of the educational aspect of adolescence; while Dr. George Wilson treated it from the mental physician's point of view. In opening the discussion which succeeded the reading of the papers, the chairman said that the period of adolescence was essentially a period of brain and bodily development, without which not only all educational efforts, but all mental, moral, and emotional efforts, would be absolutely unavailing. First and foremost, there must be a good organism; that was the Alpha and Omega.

In the afternoon, on the invitation of Professor Geddes, members of the Conference visited the Outlook Tower, Castle Hill, and from it enjoyed the magnificent view which the old city and its picturesque environs affords.

There was a council meeting later in the day, and in the evening Mr. F. Ross Mackenzie, M.A., gave a lecture on "Physical Education." Mr. Mackenzie, while recording the advance in physical education within recent years, lamented the fact that its real inwardness was not yet grasped by teachers. Gymnastics must be correct, or not at all. He advocated the introduction of the Swedish drill system, or some system having the same fundamental basis. Drill must aim at harmonious development, the co-ordination of the mental and physical powers of the individual, and the cultivation of the muscular intelligence. The lecturer recommended lessons on anatomy to senior pupils, which would enable them not only to understand the exercises given, but to take an intelligent interest in their own physical education. In concluding, Mr. Mackenzie maintained that nothing could be done on sound educational lines until a teacher's course of training embraced the study of anatomy, physiology, and psychology, and also a strict course in kinesiology.

It was our intention to present our readers with extracts from the various papers read at the Conference. This we are unable to do, as the British Child-Study Association prefers to publish the papers in its own organ, the *Paidologist*.

GERMAN AS A STUDY FOR TEACHERS.

WE are at length beginning to open our eyes to the fact that the Continent can offer us new ideas upon the subject of teaching and educational theory; we know now that often the German or French teacher is more of an artist and less of a dull mechanic than the English; we are beginning slowly but surely to recognise that some of the ideas of such men as Rousseau and Pestalozzi, the Port Royalists and Froebel, have a very vital relation to us in our daily work as teachers. Yet—and here is the surprising fact—comparatively few teachers, in primary schools at any rate, are able to read French and German—more particularly the latter—with their feet on the fender. In short, the vast majority of us are shut off from the very sources of pedagogic wisdom. Translations we have in abundance; yet no translation can give the true inwardness of Pestalozzi's *Lienhard und Gertrud*, the quaint simplicity of phrase and the fearful intensity of conviction of this great apostle of education for the poor; the greatest of philosophers find it hard to convey to us the wise subtlety of Herbart in any adequate manner. But this very subtlety—a fine essence so easily lost in transmission from one language to another—may be in large measure appreciated by the man who can read the original with fair facility. For ideas are more at their ease when conveyed in the language of the man who gave them being, and so are more easily assimilated. There is an intangible connection between word and idea—a sympathy which we cannot explain, and of which we are none the less aware. This seems to me to be a perfectly adequate reason for learning more of the language of great teachers and educators—German, the language of the most deep-thinking people on the face of the earth. Yet no crusade of any importance has been raised by teachers against the intolerable strain of certificate hunting, or against the conditions that make such sport necessary, in order that time may be left for the pursuit of more important ends—for the acquirement of an educational knowledge as opposed to a South Kensington knowledge. Might not the indictment be brought against us with moderate truth, that we worship the man of many certificates, and despise the man of much thought because of his supposed want of practicality? How long shall we continue to bow the knee to Baal in this manner? We fight for security of tenure; shall we not fight for a right to educate ourselves instead of perpetually certificating ourselves?

Yet we do not even seize the opportunities offered us by the wisdom of "My Lords." German may be taken, for example, as a subject of pupil-teacher study; but it is not very often taken. And here we are bound to confess that the reason it is not taken is in many cases the fact that French is supposed to be easier! But if this were so—which I deny—is it an adequate reason? When discipline of mind, culture, and breadth of outlook are put over against examination success, must the former always go to the wall? Is the mind of the young teacher to be cribbed, cabined, and confined that he may take a high place on an examination list? That were a worshipping of false gods in truth!

But we will not contend so strongly for more German teaching without adducing more facts in support of our contention as to its value. We have no desire and no reason to support the claims of German by belittling those of other

subjects. That were both illogical and ungrateful, and we do not wish to lay ourselves open to the charge that we are either. We do not ask for supremacy of German teaching over other language teaching, but we *do* ask for equal rights.

Let us consider German first of all from the utilitarian standpoint—that is, as a paying subject. This is the lowest of all standpoints confessedly, and therefore we will take it first. German is by common consent an important commercial language; yet, if there be any truth at all in consular reports, English commercial travellers carry the conviction that theirs is the best language on the face of the earth to the length of refusing to learn any other. This is no doubt partly due to the lack of really qualified teachers of German. We *are* awakening to the value of German as a commercial asset. Then what is the logical conclusion to be drawn by teachers? Surely this, that they should learn German in order to be able to supply a want. More people will need modern languages, I take it, in ordinary commercial life than will ever feel a need of chemistry and physics. If this be so, wherefore the predominance of the latter subjects in so many of our technical schools and institutes? Or rather, let us say, why this preponderance of technical schools over commercial schools? Chemistry and physics are valuable as mental training, without doubt; but are we not in danger of overvaluing them as commercial assets? Are there enough breweries for all the chemists who are turned out every year, and is an advanced knowledge of physics absolutely necessary for the adequate equipment of a cashier? Let us not accept unquestioningly this shibboleth of scientific training being so absolutely necessary to commercial supremacy. The contention here raised is that there is more demand for foreign correspondents than for analytical chemists and engineers. Let us draw the logical conclusion.

Now we may leave the consideration of utility pure and simple, and turn to the question of the educative value of German to our young teachers. We have spoken already of its value to the teacher as educationist; let us now consider its value to him as human being—for the human in us must of necessity react upon the philosophic.

German deserves to be studied as a means to the end of culture. Outside our own there is possibly no such suggestive modern literature as that of the Germans. The man to whom *Faust* is but a name, who knows nothing of the idyllic charm of *Hermann und Dorothea* or *Wilhelm Tell*, has yet to drink of one of the deepest and purest wells of inspiration. And above all others, the teacher must drink in inspiration, for he himself has in turn to inspire others. Truly the deep joys of such literature as this, with their inevitable effects upon character, are worth the sacrifice of many advanced S.K. certificates!

Our Board of Education is now year by year offering facilities for students specially recommended by their college to go abroad in order that they may study foreign educational systems, and may incidentally learn the language. This is a welcome step in the right direction, yet remarkably few students seem to work with this end in view. Is it not worth some sacrifice? Foreign travel cannot but add materially to the mental and professional equipment of the teacher. A chance to see foreign manners and customs cannot but broaden one's views and make one doubtful of their finality. Moreover, one comes into living touch with the environment of those who have written their country's great books. The fact that one has lived in the town of Goethe or Schiller cannot but make their books more real and living. The intonation of a foreign language spoken by natives is an inlet into the nature of the people. But the advantages of German as a part of a teacher's mental pabulum are by this time, I hope, fairly obvious. All that remains now is for some few enthusiastic natures to take fire, to hasten to seize this too long neglected treasure, and this article will not have been written in vain.

THE Education Committee of the Borough of Doncaster have recently considered tenders for the exclusive supply of school books, stationery, and apparatus, and have accepted the one submitted by E. J. Arnold and Son, Limited, Leeds.

THE ROYAL COMMISSION ON PHYSICAL TRAINING.

(*Scotland, 1902.*)

THE REPORT.

BY H. RIPPON-SEYMOUR, A.C.

IT is perhaps no exaggeration to say that when this Commission was first constituted, much doubt as to any ultimate benefit likely to be derived by the nation generally or the children in particular was expressed by the man in the street.

But a careful, nay, even a hasty inspection of the Report (vol. i.) will show how thoroughly and conscientiously the Commissioners have performed their task, and their recommendations fully prove how much need there was for investigation. These recommendations can only have been made after long and serious consideration of the mass of evidence presented, and if but half of them are adopted will undoubtedly "conduce to the welfare of the pupils," and "contribute towards the sources of national strength."

For precisely a year the Commission has been at work, hearing and considering evidence, and drawing up their final opinions. With the expert assistance of Drs. Hay and Leslie Mackenzie, they have carried out a thorough medical and scientific inquiry into the existing physical conditions of the children attending Scottish elementary schools.

These investigations were considered necessary in order to discover, and place beyond all doubt, whether the necessity for systematic physical training did exist; and for this purpose the medical examination of 600 girls and an equal number of boys, of different ages, was undertaken, the children being chosen by ballot.

The cities chosen for the inspection were Edinburgh and Aberdeen, which, it was thought, would be fairly representative of the general state of affairs throughout Scotland.

The tabulated results of this examination are to be found in the Appendix, and in many respects form a most interesting part of the Report. It is not too much to say that a really terrible state of affairs is disclosed, and the necessity for regular medical inspection of all the children and their better physical training is proved beyond doubt.

The points most particularly observed by the examiners were—height, weight, nutrition, disease, mental condition, deformity, clothing, and cleanliness.

With regard to the information presented in this medical report, perhaps the first point to strike one is the great difference between the general health and physique of the Edinburgh and of the Aberdeen children in favour of the latter. This may perhaps be accounted for, in some measure, by the greater number of middle-class children in the Aberdeen Board schools than in the same class of schools in Edinburgh; still the Commissioners are of opinion that "there exists a stratum of degeneracy in Edinburgh not reached in Aberdeen."

The statistics prove that any deterioration and degeneration existing is caused primarily by (*a*) the quality of housing, and (*b*) the quality of food, which apparently always correlate; and it is stated that "there exists.....an undeniable degeneration of individuals.....where food and general environment are defective, which calls for attention and amelioration in various ways, one of which is a well-regulated system of physical training."

Some idea of the state of the average child of the working and lowest classes may be obtained from the following figures:—

There are in Edinburgh Board schools roughly about 32,000 children, and in similar Aberdeen schools about 25,000. Among these children there are in Edinburgh some 700 cases of unrecognised phthisis, 1,300 cases of unrecognised heart disease, and at the very lowest computation 10,500 children requiring medical attention.

The Aberdeen figures are—Phthisis, 458, heart disease, 250, requiring medical attention, 5,700, which are therefore much below Edinburgh in proportion.

The number of children who would require "special care" in physical training is—Aberdeen, 875; Edinburgh, 500.

These interesting though gruesome details may be concluded by mentioning that out of 298 girls examined, 294 had some disease or defect either of the nose, ears, or throat.

The Commissioners are so impressed with this evidence of the physical condition of the children examined that they wisely recommend a similar examination of the children in Glasgow schools, and in fact of all state-aided schools in Scotland; and further, that these examinations should be systematic and periodic, in order to detect, and if possible prevent, general disease, defects of sight and hearing, and physical and mental weakness. To a great extent this end may be accomplished by the observance of simple rules of health, and by developing the physical faculties, and these "must be taught early if they are to become matters of habitual practice."

Turning now to the evidence taken by the Commissioners, we find that 127 witnesses were examined, and consequently a large mass of evidence was collected (vol. ii.), much of which undoubtedly proves the value of and necessity for systematic physical training and drill.

Practically without exception all admitted the value of physical training from a developmental point of view; but it is somewhat curious to note that only two witnesses were able to submit *statistical evidence* of the results of physical training to children, "as tested by the standards of height, weight, and girth." This lack of *proved* results is undoubtedly accounted for by the unsystematic physical training now existing in the majority of elementary schools; and such records should be kept in future.

Several witnesses had a great objection to the inclusion of *military drill* in any system of physical training, and to a limited extent this objection is wise. This country at present will not tolerate anything even remotely approaching "militarism" or "conscription," and the Commissioners were at great pains to convert those witnesses who at first imagined some connection between military drill in schools on the one hand, and conscription on the other.

The majority of witnesses best qualified to speak on the subject, such as headmasters, etc., strongly advocated the desirability of including some form of drill—not necessarily to be *called* "military"—in any complete system of physical training for schools, chiefly from its disciplinary value; and the Commissioners "were much impressed with the weight of this evidence."

After due consideration of the whole of the evidence, the Commissioners make eleven distinct recommendations, the chief of which are as follows:—

Elementary Schools.—A recognition of the proper place of physical training in relation to education is necessary; larger provision of playgrounds and exercise halls, and of organised games.

Higher-class Schools.—A certain amount of systematic exercise should be held to be necessary, and all pupils should avail themselves of the opportunities offered.

Training Colleges.—No training colleges should receive Parliamentary grants unless some systematic physical training forms part of their curriculum. They are therefore strongly recommended to provide thorough and regular instruction of this kind, under the most skilled teachers who can be procured.

Universities.—The condition of physical training here is most unsatisfactory, and the authorities should provide adequate opportunities for exercise.

System.—Certain principles should be carefully observed and followed, and a fundamental uniformity of method maintained. It will be necessary to form a skilled committee to prepare, under the Education Department, a model course of physical training, embodying the best points of all known systems, to be called "A National System of Physical Training" for Scotland.

Teachers.—In all elementary schools the physical instruction should be given by the ordinary staff. They should be certified by the Education Department as qualified to give such instruction, and would, therefore, require to obtain a certain amount of systematic training.

Institutions for Physical Education.—In future, any such institutions certified to be efficient, and carrying on the training of teachers, should be eligible for grants, as are training colleges at present. The award of certificates to those who have undergone the training should be only on the recommendation of an expert, appointed by the Education Department.

Inspection.—There should always be on the inspecting staff persons who have given special attention to this subject.

Medical Inspection.—School Boards should have command of medical advice and assistance in the supervision of schools; systematic records of physical and health statistics should be kept; and a small number of medical and sanitary experts should be added to the inspecting staff.

These, then, are the principal recommendations affecting the teachers and the children in elementary schools, and very sensible and necessary they seem.

The Commissioners are of opinion that a minimum of two hours per week should be allotted to this branch of education; and certainly, in the case of elementary schools, especially those in the poorer districts of towns, this is not too long a period.

The question of the physical training of youths who have left school (14–18) was also considered, and it was hoped that the continuation classes might help in a great measure to solve this problem. Compulsion, unfortunately, is practically impossible here. The Boys' Brigade, Cadet Corps, and the Volunteers are highly spoken of, and it is hoped that large numbers of children and young men respectively may make use of these admirable institutions.

The question of feeding, which engaged the Commissioners' attention, is a difficult one. It has been suggested that ill-fed children should be supplied with food by the School Board authorities, and their parents forced to pay for these meals. Whatever may be said for or against this idea, legislation would be necessary to enforce it, and it is scarcely likely to be put in force at present.

A few words as regards the system to be drawn up and adopted may not be amiss. The children being of different ages and sex, of varied physical abilities and, one might truthfully say, disabilities, it is obvious that any system, to be suitable, must be very elastic and admit of careful grading.

This point has been considered in the Report; and it is recommended that the system should be capable of being modified to suit "(*a*) the very young, (*b*) boys and girls between 9 and 12, (*c*) boys over 12, (*d*) girls over 12, and (*e*) the weaklings, delicate, ailing, and deformed."

It might here be further suggested that, after medical inspection, those children certified as requiring "special or careful training" should be exercised daily in a class by themselves, and under a *specially qualified* teacher, and not as hitherto—simply according to their supposed mental abilities.

Nothing but praise is due to the Commissioners for their careful and exhaustive Report; and for the sake of the children, no less than for the country, it is to be hoped that many of their recommendations may be speedily carried out.

INDIA PAPER.—Most people know that India paper is very thin, and therefore imagine something which is almost transparent; but the most important property of India paper is that, unlike tissue and other thin papers, it is quite opaque. Large and bold type can therefore be used in printing on India paper without showing through. The use of this paper has enabled Messrs. Nelson and Sons to produce, in the New Century Library, great works of standard literature in very small space. The latest additions to this series are two volumes containing the complete works of Jane Austen, and each volume, although containing one thousand pages, has a thickness of only five-eighths of an inch, and the pleasure one feels in reading these tasty productions is enhanced by the docility with which they remain open at the right place without pressure.

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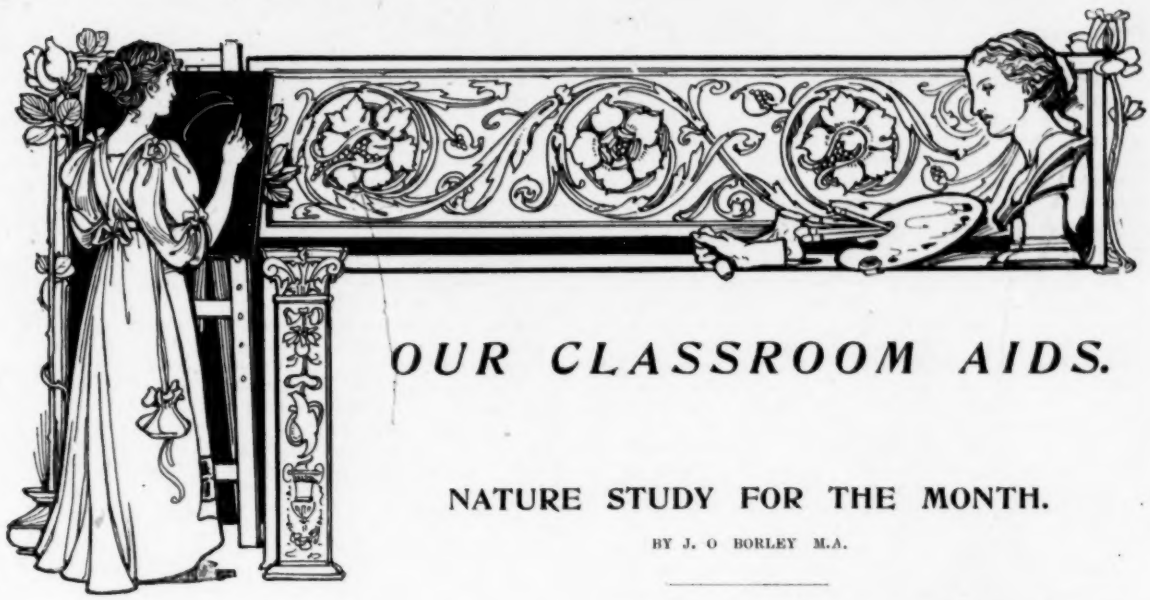


OUR CLASSROOM AIDS.

NATURE STUDY FOR THE MONTH.

BY J. O BORLEY M.A.

Snails and Slugs.

LAST month some attempt was made at the study of pond snails. It may be of service to continue the study of the same group by dealing with land snails and slugs ; for these creatures are easily obtained, easily kept, and present many interesting points of contrast, and yet kinship of habit and structure.

It will take a snail over a fortnight to travel a mile, whence, obviously, no great effort is needed to keep them under observation ; but besides this, snails have a curiously well-marked habit of returning to any resting-place once chosen. Thus, if a small trench be dug, covered with tiles, which in turn are covered with earth (excepting the tile farthest removed from the opening), snails, if placed here, will return again and again. By taking up the uncovered tile when a snail is needed for observation, one can always be found to be at home in the daytime. This plan is, I believe, recommended by Mr. Furneaux. A well-marked instance of this homing tendency was shown by as many as seven snails, each of whose shells had been marked with paint, returning morning after morning to the space beneath the same loose stone.

The snail (Helix) (Fig. 1 B) resembles its aquatic relative, but is larger, has a less pointed shell, which is more closely seated on the foot, its eyes are seated on long rod-like retractile tentacles (Fig. 1 E T) (not present in Limnæa), while the flap-like tentacles of Limnæa are replaced by rod-shaped ones (Fig. 1 T). The mouth is not on the under surface, but at the front (Fig. 1 M). The slime secreted is much more plentiful, probably because the animal has to provide the fluid on which it glides.

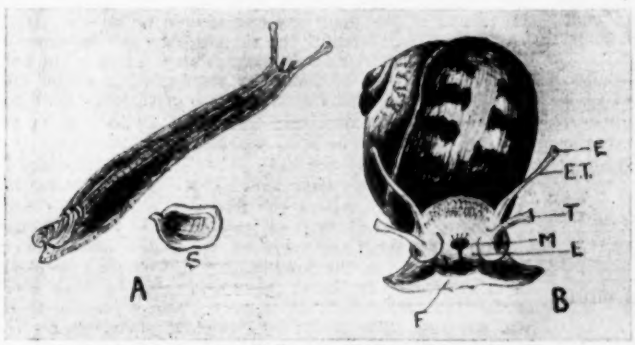


FIG. 1.—A. TESTACELLA. S, Shell. B. HELIX, FRONT VIEW (*after Howes*). E, Eye ; F, Foot ; L, Left lip ; M, Mouth ; T, Front tentacle ; E T, Eye tentacle.

Slugs may be captured for observation by leaving in a damp corner of a garden overnight a few cabbage leaves and similar refuse : the slugs will be found among the leaves in the morning. All slugs resemble the head and foot of Helix, with the hump practically shorn away ; in reality the hump is flattened into the body. There are three common English slugs : a small black one, with a small shell near the hind end—Testacella (Fig. 1 A) ; a black slug, fairly thick in proportion to its length—Arion ; and a great gray slug —Limax. A saddle-shaped longitudinal elevation near the head end of the second and third kind marks the position of the flattened hump, and in these no shell is visible. On the right margin of this elevation is, however, the opening into the breathing-chamber, which has the same position in the front of the hump as in the snail and pond snail.

We shall inquire best into this difference in form of slugs and snails by considering their habits. These moist-surfaced creatures have taken to the land, but they avoid dry places and dry heat. It is true that snails are found on the fringes of deserts, but these avoid drying up by greatly thickening their shells. In temperate countries this is unnecessary ; the creature has only to find a moist, cool crevice to rest in, and to avoid feeding in the heat of the day, to accomplish the same result—namely, hindrance of evaporation, and the consequent preservation of the moisture necessary for the secretion of the slime. Slugs have gone a step farther. The shell, which, on the whole, is lower in land than in water snails, and hence is more adapted for creeping under stones or into crevices, is reduced out of all recognition. Testacella retains a shell which has the trace of a spiral form, perhaps for protection of the hind end when in the burrows of the earthworms, on which it lives ; but Limax has not only lost all trace of spiral form, but reduced the shell to a mere flake, which is sunk completely under the skin ; while Arion has lost it, but for some scattered granules, altogether.

The explanation of the slug's present form probably, then, is that slugs had snail-like ancestors, and reached their present form by degrees, as they became more successful in their habit of seeking crevices, till at last the shell, no longer needed, disappeared ; while, as might be expected, the large surface now exposed for evaporation made more marked the habit of night-feeding already found in snails. To find the shell of the gray slug (Limax), drop one into boiling water ; on removing the skin of the hump with a penknife, the shell can be detached.

This explanation naturally presupposes that the ancestors of the snails and slugs were aquatic ; a great point in favour of this hypothesis is the vast number and variety of aquatic

forms with spiral shells, which even the collection in a very moderate museum will help the children to realise. If possible, a live whelk should be shown crawling in sea-water; if not, pictures at least should be studied. It is a far cry from a shell used as an ornament—as many large spirals are—to a great sea-snail bearing that shell over some distant beach, but it will do no harm to a child to attempt to imagine these animals, and the above means may help it to do so.

Having noted the general outward characters of our two subjects, the various parts may be studied more fully.

To remove a snail's shell, the snail should be killed by dropping into boiling water. It may not be unnecessary to say that such a death is humanely quick, and probably far less painful than most natural deaths the creature might meet; a fact worth remembering when slugs and snails have to be killed in gardening.

The snail can now be twisted out of its shell. Saw through the shell, starting a little on one side of the point at right angles to the foot of the animal in life. The appearance of Fig. 2 should be seen; and the shell is thus found to be really a twisted tube, and not a mere hollow cone, such as a candle extinguisher, with which it may well be contrasted. If we notice also the thinness and sharpness of the lip of the shell, we are on the track of accounting for the shape. The thinness shows the shell to have been formed most recently at the mouth; hence it obviously always grows at the mouth. The extracted body will be seen to be spiral. If now the shell forms as the spiral body grows, always at the widest basal part, the result must be a coiled tube, the roof of each of whose turns is in contact with the floor of the turn above it. If this description is not quite clear, the following experiment may illustrate the twisting with the growth. Take a piece of clay, shape it roughly to illustrate the foot of a crawling snail. Examine a live specimen, and place the empty shell on the clay in exactly the right position. Now remove, and gum a narrow piece of paper round the lip to resemble the new growth. Replace on clay, and the shell will be seen to have revolved slightly from its old position. Of course the coil of the body which determines the shell is not here accounted for; it is omitted as being beyond the scope of this article. If previously-killed snails are not provided for the children to extract, whelks and whelk shells are useful substitutes on account of their size.

Fig. 2.—Shell of Helix.
Cut through to show it to be a spirally coiled tube.

The rate of growth is very variable. At the approach of a growth period the snail usually buries itself, reappearing a week or two after, appreciably larger. A paint spot placed near the edge of the shell will enable the growth to be measured. Mr. Gain gives the following biography of a snail:—

August 1882.	Eggs hatched grew to $\frac{3}{8}$" diameter before winter. Fed on cabbage.
October 1883.	Shell 1" in diameter.
July 1884.	Shell 1$\frac{1}{8}$" in diameter.
May 1885.	Left winter quarters. Companion introduced.
August 1885.	Eggs laid in soil, hatched in September.
October 1887.	Old snail died, aged 5 years 2 months—a usual age.

The tentacles will attract attention. Their retraction should be watched after gently touching their ends with the finger; the motion is exactly similar to that of a glove finger drawn inwards by a thread fastened to the inside of the tip, and the extrusion can be also imitated by blowing out the glove finger. The glove in extended condition should still be slightly indented at the tip; the knot will in that case be in the precise position of the snail's eye. Look for the pit and the black eye with a hand-lens.

Although of elaborate structure, the eyes are feeble, especially in daylight. A snail sees far better at 3" or so in the dusk than at $\frac{1}{4}$" in full daylight, and both snails and slugs are what we should call very near-sighted. This may be tested by putting into a thin glass vessel a bean pod or a piece of potato, and gradually approaching it to a gray or black slug, noting the average distance at which this favourite food is perceived.

Far more serviceable is the sense of smell, of unknown seat, though highly developed.

A French naturalist records an interesting case of the use of smell. He saw a large black slug approaching a bean pod thrown by the roadside. A few steps further on another was similarly engaged. Thinking this showed evidence of attraction from a distance, he took up the second bean pod and placed it across the road. The slug immediately changed its direction. He pocketed the bean pod. The slug stopped. He held it out. The slug held up its head into the air towards it. He put it behind a stone. The slug "hurried" straight to it, and there devoured it in peace. So much for smell.

Organs, supposed to be those of hearing, have been found in many molluscs. An American naturalist relates that he knew a case of a snail that came at the call of its mistress, a little girl; but no other record is to hand.

Allied to the question of the senses is that of intelligence. Some of the following facts appear to point to the possession of memory and intelligence. Two snails were seen in a meagre garden, one of them sickly. Soon the strong one disappeared into a well-stocked garden; next day he returned, and both journeyed together into the new pastures, where they remained. A clear case of memory is that of the slug found in the morning wandering on a shelf on which was usually placed a jar of milk to which he paid nightly visits; and one of design is furnished by the slugs which, unable, owing to the gardener's precautions, to climb into the inflorescence of orchids, climbed to the roof, and lowered themselves to the flowers on a thread of their own mucus.

The action of the foot should be watched. It is difficult to describe, but of surprising strength; and snails being enticed to move by means of food might be yoked by a loop of thread on the shell to small objects, to exhibit this. As nail impeded in this way has been known to crawl vertically with nine times its own weight, and to drag along a table articles of a total weight of seventeen ounces—consisting of a pair of scissors, screw-driver, twelve reels of cotton, a key, and a knife.

By the use of a hand-lens preferably the mouth may be studied (Fig. 1). It has one semicircular upper jaw, but no side pieces, as has the pond snail (Limnæa). In the floor of the mouth is the many-toothed tongue or radula. If the snail be watched feeding, the shape of the jaw is shown by the little semicircular bites taken from the leaf. The teeth in the radula may be found by their grating action on a knitting-needle thrust into the mouth of the dead snail, and both they and the jaw may be cut out with needles and examined by any one who possesses a microscope. It is worth looking along the side of the foot with the lens for the minute openings from which the slime may sometimes be seen exuding. Above the foot is the collar, bordering the lip of the shell; and at its right side the pulmonary opening, admitting and emitting air to the mantle cavity or lung, just as in the pond snail. This opening opens and shuts rhythmically, faster when the creature is in active motion than when at rest—a very obvious parallel to our own panting. The cavity into which it opens has for roof the mantle, for floor the hump, and in the roof ramify the blood-vessels wherein the blood is becoming oxygenated.

Open this cavity in the dead snail by cutting along the upper margin of the collar and the left side of the loose skin or mantle which lies above the collar on the front of the hump: the blood-vessels will be seen (easily under water) as dead white branching tubes. If a snail be held up against the light, these vessels can be seen in the living animal by looking into the opening as it dilates. The best specimens for this purpose are those with a uniformly coloured shell

(that is, not dappled much) marked with lines parallel to the lip of the shell—in fact, *Helix nemoralis*.

The eggs are round and semi-transparent, "like gelatinous peas." The snail generally deposits them beneath the surface, the slug on the surface of the ground. They are very many in number—a black slug laying in forty-eight days batches whose total was 477, parting with three-eighths of its own weight, in eggs, in forty hours. One is not surprised to hear that "after this it ate half a raw potato, and then took a bath, remaining submerged more than an hour," nor that many deaths result from exhaustion after egg-laying. The young can conveniently be seen moving in the egg before hatching by placing the egg on a piece of looking-glass.

There are, of course, numerous snail topics on which space forbids any discussion. The great tenacity of life shown by snails, which have lain in drawers or boxes, or even glued to card labels in the British Museum for four years and more, and revived on a bath of tepid water being administered, is a mystery surpassing, in some respects, the suspended vitality of seeds. The folk-lore of snails even is quite extensive; and the (still prevalent) belief in snails taken as food as strengthening the lungs, in all its variants of asthma cure, consumption cure, special food for glass-blowers, is quite venerable in age.

Glowworms.

During May and June, as soon as dusk has fairly set in, the light of glowworms may be seen, bluish-green and phosphorescent-looking, shining among the grass and weeds of hedgerows. The glowworm, really a beetle, is not uncommon, and is perhaps most plentiful in mid Kent. These insects live on snails, and hence accommodate their life-cycle to their victims' habits. Early in spring, as the snails are leaving their winter quarters, the glowworm's eggs hatch, and the young, resembling in outward appearance the female (Fig. 3 B), begin at once to prey upon the snails. In May or June the young or larva spend a fortnight in the resting or pupa stage, and then, emerging as the perfect insect, continue their predatory career.

FIG. 3.—GLOWWORM.
A, Male; B, Female.

The two sexes differ markedly: the male (Fig. 3 A) has well-formed wings and wing-cases; the female is wingless. The male differs widely from the larva; the female resembles it closely. The female has but poorly-developed eyes; in the male they are enormously large in proportion to the head. The female gives a considerable amount of light, the male hardly any.

Glowworms can be gathered best at night, as they then advertise their own presence, lighting up the grass for an inch around them. Living on snails, they are welcome in a garden; and being in the habit of remaining for days in nearly the same spot, there is little fear of losing them. The female, naturally the easiest to find, on account of her light, is long, brown, soft, and rather flat; the head is very small (in both). The eggs are very large and yellowish, and may be found sometimes attached to grass stems, though frequently they are buried. The larva differs from the adult female both in the position of the light and in the possession of a tuft, consisting of seven or eight whitish filaments radiating from a common point at the end of the tail, into which they can be withdrawn. Their use appears to be partly to aid in locomotion, and act as supports for the long body; but they are also used to brush away the slime from the body of the larva after it has made a meal off snail.

In the larva the light seems given off by small sacs on the under side of the abdomen, and by the curving or retraction of the abdomen it can be hidden. In the female the light is emitted from the last three segments of the abdomen. It is not persistent nor definitely rhythmical; it may sometimes be withdrawn without apparent cause.

The function of the light is a mystery. Useful, one would suppose it must be, as it is so well developed; and as not only the adult insect, but larva, and even eggs, are luminous, it seems probable that some peculiar chemical action of the tissues inevitably gives rise to a light which has then been seized upon and developed for unknown but definite ends. It may serve to attract the male. It is true that male glowworms have better developed eyes than the females, and that they often fly into lighted rooms; but good eyes are a necessity for flying creatures, and attraction to a light is not peculiar to glowworms. The nearest American relations—"the lightning bugs"—reverse the order, by possessing brilliant males and inconspicuous females. In these the light is definitely rhythmical, growing to a climax and fading as many as thirty-six times to a minute. It here seems to actually light the insect in its flight, as the following experiment shows. A firefly of constant light was taken, and one of the two light-giving areas was covered with a thin layer of wax—the animal moved in a curve; when both were covered, it would only walk, and that uncertainly, after tapping the ground in front with its antennæ.

The nature of the light is unknown. Being increased when the glowworm enters oxygen, it is probably due to chemical action; and the rhythmic action of the most brilliant kinds points—like the increase on irritation, and the occasional sudden darkening—to the luminous substance being secreted under the guidance of nerves.

Many interesting facts, and some not-facts, could be told of these insects. It seems difficult to exaggerate the brilliance of tropical forms. In Cortes's time a garrison mistook a swarm of them for the matchlocks of an enemy, and to this day they are used imprisoned in gauze as ornaments. They are caught by being attracted by a live coal whirled round on a string, and during captivity are carefully bathed once a day in tepid water, and fed at night with sugar-cane.

A specimen of a glowworm mounted in a transparent celluloid box may be obtained of Messrs. Arnold of Leeds for a shilling.

NATURE KNOWLEDGE.

BY JAMES KNIGHT, M.A., B.SC., F.C.S., F.G.S., F.E.I.S.,
Head-master, St. James's School, Glasgow.

LESSONS ON FOOD: ANALYSIS OF MILK.

THE following lessons are intended for girls of ages twelve to fourteen—that is, for girls who are getting cookery and laundry lessons, or who are taking the "Household Management" supplementary course under the Scotch Code of 1903. They will be of greatest service when co-ordinated with practical work in the cookery room, and should be taught entirely as experimental lessons.

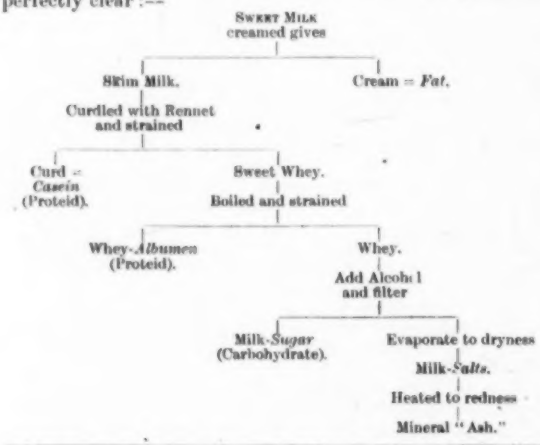
As a typical food, take a glass of milk. The children are familiar with most of its derivative foods, such as butter, cheese, curds, whey, the scum of altered casein which forms on heating milk, and to a less extent with milk-sugar. Milk is thus a compound food, containing several simple food-stuffs, "proximate principles," as they used to be called, and a simple analysis of milk will lay the foundation of the usual classification of foods.

First, to show that milk contains fat, a test-tube of milk may be set to stand for twenty-four hours so as to show the formation of cream, and this, on being removed, leaves skim milk. This popular analysis is not very satisfactory, since cream contains besides milk-fat small quantities of the other milk-solids, besides some 40 per cent. of water, while the skim milk left contains about 1 per cent. of fat. A more complete separation of the milk-fat is effected by centrifugal separation; practically all the fat is removed as cream, while the separated milk contains the other milk-solids and nearly all the water. The principle of separation may be shown by stirring water in a bowl containing some cork chippings

or other light substances. As the water is stirred round quickly, the light substances gather in the centre, forming the vertex of an inverted cone, while the heavier parts gather at the circumference. Take a tall, narrow-necked bottle, like that associated with castor-oil, fill it up to the shoulder with milk, cork it firmly, and fasten the neck securely to a stout string, then whirl the bottle for a minute or two at not less than two revolutions per second. On standing, the cream will be found very well gathered as a froth in the neck. Four such bottles fastened to the hind wheel of a bicycle may be revolved very rapidly on working the cranks by hand. The presence of fat in milk is easily shown by the use of chemical solvents, such as hydrochloric and sulphuric acids, ether, benzene, chloroform, etc. Take a small flask or boiling-tube and put into it one-fifth of milk and the same bulk of strong hydrochloric acid. Boil, shaking constantly, till the liquid turns dark brown, showing that the casein has been all dissolved; cool in water, then fill up with ether to dissolve out the milk-fat; shake, and allow to stand; then the fat solution will be found at the top as a clear yellow liquid, which may be decanted or siphoned off.

Returning to the glass of milk which has been skimmed of its cream, add a square inch of rennet (or some rennet extract) to this, and keep at blood-heat for about fifteen minutes. This produces a curd, which forms the basis of cheese, and leaves a watery liquid called sweet whey. Break up the curd by a fork, and separate all the whey by squeezing through muslin, then boil the whey. A skin gathers on the surface; this is milk-albumen, popularly called "fleetings," a substance similar in composition to the curd. On removing this by a muslin strainer, the sweet whey is obtained very clear. Now add half its own bulk of alcohol (rectified, not methylated spirit): this precipitates a fine white powder, which turns out to be lactose or milk-sugar. Filter the liquid through blotting-paper so as to retain this milk-sugar, then slowly evaporate to dryness the filtrate itself. This process boils off the excess of alcohol and water, and leaves a dry white powder, the milk-salts, which, if further heated to redness for some time, give the mineral matters of milk, the so-called "ash" of chemical analysis.

Milk thus contains representatives of the five great divisions of food-stuffs—namely, (1) proteids or nitrogenous foods, represented by casein (curd) and milk-albumen ("fleetings"); (2) fat, represented by butter; (3) carbohydrates, represented by lactose or milk-sugar; (4) mineral matters or salts, containing, among other things, phosphorus and lime; (5) water. A table will make the above procedure perfectly clear:—



THE HOME COUNTIES NATURE-STUDY EXHIBITION.—A committee, consisting of members of the Middlesex Field Club and the Selborne Society, and other persons interested in the advancement of nature study, has been formed for the purpose of organising another exhibition on similar lines to the one that met with such success last year. It is hoped that the gardens of the Royal Botanic Society may be available as before, and we shall be pleased to announce particulars of the arrangements as soon as they are completed.

THE INSPECTOR'S NOTEBOOK.

BY AN INSPECTOR OF SCHOOLS.

An Apology. In my March notes I quoted from the new sensational book by that rising educationist, Dr. Frank Hayward, M.A., B.Sc. The correct title of his work is *The Reform of Moral and Biblical Education.*

The Swing of the Pendulum. The agitation against mere inspection as opposed to examination is at last making definite headway, as the following addition to Article 22 will show: "The inspector may, where he considers it desirable, hold a formal examination of any class in the school upon the work done by the class during the previous six months; but not less than six months' notice will be given before such examination is held." The position of an inspector employed by the Whitehall authorities has to some extent been somewhat indefinite for some time past. I have always believed one had the power to test informally any subject in any class, but unquestionably the tendency has been against examinations. It is to be hoped that it will be unnecessary to put Article 22 (*b*) into operation to any great extent. Any examination of a formal kind is bound to encourage mechanical work. There is no fear of examinations becoming anything but the exception. Inspectors of the secondary side do, as a rule, more examining than their primary colleagues. Probably it is more necessary with secondary schools.

Article 68. "The Board may require arrangements to be made for the due training of such teacher." This is meant as a distinct warning note to all employed under the vaccination certificate. The time is fast coming when the financial reasons for their employment will disappear. There is to be a general levelling up of the staffs, both as regards quality and quantity.

I am constantly being consulted as to when the sword of Damocles will fall on the unhappy heads of the "animated broomsticks." It is certain that nothing very drastic will be enacted. Whatever change is introduced in the next Code, you may be sure it will be a mild reform. The brigade of 12,000 will be weeded out gradually. Many of them could not pass Standard V. Many have failed at the King's Scholarship Examination, and are useful teachers. My advice to all who have any ability as students, and are fairly young, is to at once prepare for some such examination as the Aberdeen Women's, and so become duly qualified under some safe article of the Code. Write for information respecting this examination to the Registrar, University, Aberdeen. On pages 40 and 41 of the 1903 official Code you will find a list of twenty-seven examinations, any one of which qualifies under Article 51 (*b*). It would be well for those who think seriously of qualifying to write to one of the many correspondence colleges for advice. (See educational papers.) I am prepared to give advice, too, providing applicants send me full particulars as to their education. In connection with this subject, it should be noted that Article 49* is likely to become inoperative after March 31, 1904. This article permits those who have failed at the King's Scholarship Examination to become, by permission of H.M. Inspector, provisionally recognised as assistants for two years subsequent to the last examination taken by them during apprenticeship.

School Boards and Cash Balances. Many School Boards have been doubtful as to what would happen to the cash balances in their hands at the time of their apotheosis. One gentleman told me he proposed to most minutely calculate his final estimate, so that the County Council should have no spoil. The matter has been finally put to rest by an authoritative statement by the Board of Education, which says that the Local Government Act, 1894, "makes adequate provision for the adjustment of all such balances to be effected by agreement between the School Boards and the new Authorities." There is consequently no need for clerks to give themselves the extra trouble which would be necessitated to ensure an empty treasury on the arrival of "the appointed day."

Clay Modelling as an Occupation.

Clay modelling is an excellent occupation when properly taken. I have seen the occupation badly done in several schools recently, so I will venture to offer a few suggestions. To begin with, it is highly necessary that the teacher shall know a little herself. It is useless to give out lumps of clay and allow the children to do what they like with them. Plenty of plasticine or clay must be available. Each child should have a little board to work on, a short piece of stick, and a sponge. There must be an ample supply of objects. If it be a nut, then every child should have one, or at least there must be one model between two or three children. Half the value of the lesson is gone when the only object is the one the teacher has. There should be a carefully graduated scheme. Children must not be allowed to model anything they like, except as a recreation occasionally. When modelling, say an ivy leaf, the child should not place the real ivy leaf on some clay and cut round to obtain the right shape. That is not modelling. The object lesson must be linked with the clay-modelling lesson. The teacher should attend a class on the subject, if possible; and if not, she should work out her models before giving her lessons.

The "Notebook" Query Column.

Letters intended for this column should be addressed "Inspector," care of Editor, Practical Teacher. Only in very urgent cases can replies be sent by post, and then only when two stamps accompany the letter.

W. E. G. applied on March 4 for permission to sit for blackboard, but was told he should have applied before March 1. He desires to know whether, if he takes the one other subject recognised for an elementary drawing certificate without taking blackboard drawing, he would obtain marks therefor at the forthcoming Certificate Examination.

Answer.—I suppose the rule about March 1 is a local one. I should apply again, asking whether there is not some error, as the official date is March 18.

In any case I should take the other subject. You will be almost sure of obtaining marks.

A. G. C. obtained a third class at the last Scholarship Examination. His goal is the B.Sc. degree. He wishes my advice as to whether it would be wiser to prepare for the next Scholarship Examination, or for the January Matriculation.

Answer.—By all means, if you desire to go to college, postpone the Matriculation, and enter for the King's Scholarship again. London Matriculation is much harder than King's Scholarship. If you failed in January, what would it profit you? I take it your desire is to become a certificated teacher. If you do well at King's Scholarship, you may be able to take up university work in college.

M. E. asks—(1) Is drawing for Certificate 1903 obligatory? (2) Is botany compulsory? (3) Is it necessary for unsuccessful candidates to be re-examined by a doctor when sitting the second time?

Answer.—(1) No. (2) No, but you must not omit the whole of Section B. (3) Yes, I believe so.

A. G. asks whether blackboard drawing is a failing subject at the Certificate Examination.

Answer.—No. See also reply to W. E. G. above.

E. D.—With reference to the Certificate Examination, how may those taking approved special courses obtain permission to sit?

Answer.—The Board of Education has already instructed the local secretaries and examination secretaries to admit to the May and June examinations, without fee of any kind, acting teachers on production of Form 26 for compulsory subjects, or of Form 26 (S.D.) for the optional subjects. A written statement from the correspondent of the school at which they are employed, that they are taking the above-named subjects for the Certificate Examination, would suffice as an alternative to the above.

The results of the Science and Art Examinations will not be announced to such, nor will they receive any certificates.

Epidemic.—There is no longer any grant payable for those absent through epidemics. By reference to the new Code just out, you will see that the article is cancelled. "The amounts paid under Article 101 * to individual schools have, as a rule, been inconsiderable as compared with the total income and expenditure of the year. Many difficulties, too, have been found incident to the administration of the article." The money is to be devoted to the improvement of the instruction given to pupil teachers.

A. H.—The "Model Course" is to be followed unless you have submitted and had approved an alternative scheme. This alternative scheme need not now be sent to the Board for approval. The inspector of the district has the power to approve such schemes. You should spend one hour weekly, and you should not take it during the recreation time.

HISTORY DAY BY DAY.

June.

1st. *Lord Howe defeated the French off Brest, 1794.*—"The Glorious First of June" not only served to maintain the naval supremacy of England, but also in some measure retrieved the misfortunes that attended the British arms on land at this time.

Drumclog, 1679.—The severe measures passed against the Covenanters led to open resistance. Archbishop Sharp was murdered by some of the most daring spirits, who then fled to the moors, where they defeated a small body of royal troops under Graham of Claverhouse in a skirmish at Drumclog.

2nd. *Gordon Riots, 1780.*—Sir George Savile having carried a Bill for the amelioration of the condition of the Roman Catholics, Lord George Gordon, a half-crazy peer, led a mob down to the House of Commons to demand the repeal of the Bill. Failing this, the mob plundered and burnt several Roman Catholic chapels, and attacked the residences of many prominent Catholics. For six days a large portion of London was in the hands of the mob, and the military had to be called out before order could be restored.

3rd. *Death of Plimsoll, 1898.*—The best memorial to this great philanthropist is the load-line marked on the side of every British vessel to prevent the ship being overloaded. The greater part of Plimsoll's life was devoted to a crusade against the practice of sending vessels to sea in an overloaded and unseaworthy condition.

4th. *Battle of the Dunes, 1658.*—Cromwell's animosity towards Spain led him to form an alliance with France, and to assist that country in her attack upon Flanders. The victory of the Dunes, which gave us Dunkirk, was largely due to the valour and discipline of Cromwell's Puritans.

5th. *Pretoria taken, 1900.*—The Boer capital was known to be strongly fortified, and it was feared that it would only be taken after a long and arduous siege. But the rapidity of our movements completely took the Boers by surprise. Three days after entering Johannesburg, Lord Roberts was on his way to Pretoria, and two days later saw him enter that city.

6th. *Petition of Right, 1628.*—This famous petition recited all the statutes that protected the subject against arbitrary taxation, against loans and benevolences, against punishments otherwise than by lawful judgment of his peers, against billeting of soldiers on private houses or the enactment of martial law in times of peace. In order to obtain supplies for a new expedition to Rochelle, Charles gave his consent to the petition; but he had previously obtained the opinion of his judges that this consent would leave his rights untouched, and as interpretation of the petition rested with the judges, Charles considered that his position was secure.

7th. *First Reform Bill, 1832.*—By this Bill forty-one boroughs were disfranchised, and one member was taken from each of thirty others. These seats were given to the towns that had sprung up in the great industrial districts. The Bill had been rejected by the Lords the previous year, but the threat to create fifty new peers to swamp the opposition proved effectual, and the Bill was passed.

8th. *Death of the Black Prince, 1376.*—As a military leader the Black Prince has had few equals, but this renown is dimmed by the cruel and heartless manner in which he conducted his campaigns, and by the fearful massacre of Limoges, when 3,000 men, women, and children in the rebellious town were butchered in cold blood.

9th. *Death of Bruce, 1329.*—Grandson of the original claimant of the Scottish crown, Bruce received his early training in the English court. The discovery of an intrigue roused the jealousy of Edward, and Bruce fled across the Border. At Dumfries he met Comyn, by whose instrumentality the intrigue was discovered, and slew him; he then threw off all semblance of loyalty to Edward, and assumed the crown. He was compelled to fly for safety to the western isles, but returned on the death of Edward. The victory of Bannockburn made Bruce master of Scotland, whose independence was acknowledged by the Treaty of Northampton, 1328.

10th. *Attempt on the life of Queen Victoria, 1840.*—Edward Oxford, a lad of seventeen, fired two shots at the Queen as she was driving along Constitution Hill. The jury found him insane, and he was sent to a lunatic asylum.

11th. *Insurgents gathered on Blackheath, 1381.*—The imposition of a poll-tax on every person in the realm goaded into action the labourer and the artisan, who had already commenced the first "Labour War" which has occurred in this country. The first outbreak was in Kent, where the peasants rose to protect Wat Tyler from the result of his hasty action. Having plundered the palace of the Archbishop of Canterbury, the insurgents made their way to Blackheath, where they awaited reinforcements.

12th. *Meeting of the Mad Parliament, 1258.*—This assembly was held at Oxford, and passed the celebrated "Provisions of Oxford." These made the first effort toward popular representation by enacting, "the commonalty shall elect twelve honest men who shall come to Parliament to treat of the wants of the king and of his kingdom."

13th. *The Berlin Conference, 1878.*—Through the mediation of Bismarck, a conference was held at Berlin to consider the whole of the terms of the Treaty of San Stefano (March 3). Lord Beaconsfield took the unprecedented step of attending the conference in person, accompanied by Lord Salisbury.

14th. *Naseby, 1641.*—This victory was entirely due to Cromwell and his Ironsides. A fierce charge by Prince Rupert had routed the wing under Ireton, and the centre, under Fairfax, was slowly giving way before the fierce onslaught of the Royalists, when Cromwell, having put the Royalist left wing to flight, fell on their centre, and turned defeat into victory. The king's artillery and baggage, including the royal papers, were captured by the Parliamentarians.

Battle of Marengo, 1800.—Having crossed the St. Bernard, Napoleon completely crushed the Austrians, and compelled them to surrender Lombardy.

15th. *The Signing of Magna Charta, 1215.*—Finding resistance hopeless, John called a conference of the barons at Runnymede. Here the Great Charter was discussed, agreed to, and signed in a single day. This charter, which is looked upon as the basis of English liberty, was founded upon the charter of Henry the First, and itself established no new constitutional principle. The unwritten customs were, however, now committed to writing, thus marking "the transition from the age of traditional rights, preserved in the nation's memory, to the age of written legislation, of parliaments, and statutes, which was soon to come."

16th. *Quatre Bras, 1815.*—Within a few months of his flight from Elba, Napoleon found himself at the head of 120,000 men, mostly tried veterans. To oppose this formidable army, Blucher and Wellington hastened to join forces; but Napoleon threw himself between the two, and dispatching Ney to oppose the British at Quatre Bras, fell upon the Prussians and defeated them at Ligny.

17th. *Retreat to Waterloo, 1815.*—Although Wellington had successfully held his ground against the attack of Ney, the retreat of the Prussians left his flank exposed, so he withdrew to Waterloo. Leaving Grouchy in pursuit of the Prussians, with strict orders to prevent them joining the British, Napoleon directed his attention to Wellington.

18th. *Waterloo, 1815.*—As regards numbers, the opposing forces were about equal, but Napoleon had the advantage in guns and cavalry; his army, too, was composed mostly of veterans, whilst a large part of Wellington's force consisted of Belgian levies, who fled at the first charge. Recognising the fact that the British must be crushed before the arrival of the Prussians, Napoleon flung column after column upon the British squares, but without effect. At 4.30 the British were encouraged by the approach of the Prussian advance guard, and the approach of the main body compelled Napoleon to stake all upon one last desperate charge. Drawing up his Imperial Guard into two columns, he dispatched the first under Ney; but the terrible musketry fire shattered it, and it broke within a few yards of the British line. The second column met a like fate, and from that time all was lost.

19th. *The "Alabama" destroyed, 1864.*—This famous privateer was built on the Mersey expressly for the Confederate service. During her career she captured nearly seventy Northern vessels, and was finally sunk off Cherbourg by the *Kearsage*. The American Government claimed compensation for the damage done to its shipping, and on the matter being referred to arbitration, the sum of 3¼ millions was awarded by the Geneva tribunal.

20th. *Monmouth proclaimed at Taunton, 1685.*—The farmers of Devonshire and Dorset flocked to the standard of Monmouth after his landing at Lyme, and by the time he reached Taunton his army numbered six thousand men. Here he was welcomed with every sign of popular enthusiasm, and formally proclaimed king.

21st. *Cadiz captured, 1595.*—Finding that Philip was preparing to carry out his threat of another Armada, an English force attacked Cadiz, plundered and burnt the town, fired thirteen vessels lying in the harbour, and utterly destroyed the stores which had been accumulated for the expedition.

Vittoria, 1813.—Overtaking the French at Vittoria, Wellington utterly defeated them, and drove them in hot haste across the Pyrenees, thus freeing the Peninsula from the invaders.

22nd. *Bothwell Bridge, 1679.*—Encouraged by their success at Drumclog, the Covenanters gathered in large numbers, but the undisciplined peasants were slaughtered like sheep by the royal troops under the Duke of Monmouth.

23rd. *Plassey, 1757.*—Clive hastened to Bengal to avenge the terrible "Black Hole of Calcutta," and with a mere handful of men he routed the vast army of Surajah Dowlah. This victory laid the foundation of our Indian Empire.

24th. *Bannockburn, 1314.*—Taking up a strong position on the rising ground with the Bannock on one flank, Bruce further strengthened his position by digging pits, and by driving stakes into the ground. These threw the English men-at-arms into complete disorder, and mistaking a body of camp-followers for reinforcements, panic spread through the English host, which broke into precipitous flight.

25th. *Repeal of the Corn Laws, 1846.*—The efforts of Cobden, Bright, and other members of the Anti-Corn Law League had influenced public opinion to a considerable extent, and the failure of the potato crop in Ireland made it evident that the duty on corn would have to be removed. On June 25 the Bill passed the Lords; but in the hour of his triumph, Peel was defeated on the Coercion Bill for Ireland.

26th. *Massacre of Cawnpore, 1857.*—Finding that the effort to throw off the British yoke was unsuccessful, and that it was impossible for him to hold Cawnpore against Havelock, Nana Sahib determined to put his prisoners to death. The few men among them were shot, whilst the women were slaughtered like beasts in the shambles; the bodies, stripped of anything worth taking, were then tumbled into a dry well.

27th. *Dettingen, 1743.*—George the Second warmly supported the claims of Maria Theresa, and himself led a force of 40,000 men to the Maine. The appearance of a superior French force made his surrender apparently inevitable, but the stubborn courage of the British troops enabled him not only to hold his ground, but even to compel his opponents to recross the river.

Surrender of Dunkirk, 1662.

28th. *Victoria crowned, 1838.*

29th. *Cropredy Bridge, 1644.*—After being besieged for a month at Oxford, Charles effected his escape, followed by Essex and Waller. Avoiding the former, he turned suddenly on Waller and completely defeated him.

30th. *Seven Bishops acquitted, 1688.*—Although the jury had been carefully packed by the sheriffs, public indignation overawed judge and jury alike, and the verdict of "Not guilty" was received with universal rejoicing.

Beachy Head, 1690.—The French fleet, under Tourville, met the combined Dutch and English fleets off Beachy Head. The English admiral, Herbert, either from treachery or cowardice, lay idly by and left the whole of the fighting to the Dutch, who, overcome by superior numbers, were compelled to withdraw and seek shelter in the Thames.

THE TEACHING OF PRACTICAL GEOMETRY.

BY W. H. FOSTER, B.A. (LOND.), ST. JOHN'S COLLEGE, CAMBRIDGE.

WHEN a section of the course, such as the one described in the last article, has been completed, all the definitions that have been given, and the properties of the figures that have been illustrated in the exercises, should be collected and entered in a book kept for the purpose. These should then be learned thoroughly, so as to be ready when required for use on future occasions.

Section B.—On Angles, especially the Right Angle.

In order to introduce the pupil to another series of interesting exercises, it is necessary that he should be able to construct a right angle. We proceed, therefore, to define a right angle; but it will be necessary first to explain the term "angle," which we avoided purposely in the first series of exercises. It is better to adopt the modern definition at once—that is, to introduce the notion of rotation.

Definition of Angle.—Imagine a line OP capable of revolving round O, to start from coincidence with another (fixed) line OA,

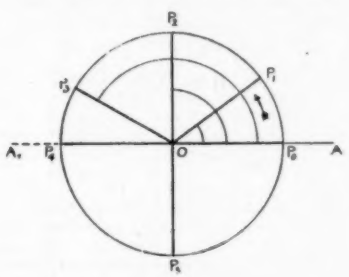


FIG. 1.

and to revolve into the position denoted by OP_1. We say OP has then traced out the angle AOP_1.

Let OP continue to revolve (in the same direction): it will trace out a larger and larger angle, until at length it comes to lie on OA_1, which is OA produced through O. There must be a position for OP *midway* between OA and OA_1. When OP has reached this position (as at OP_2), it has then traced out what is called a *right angle*. When it has reached OA_1, it has gone over *an amount of angular space* equal to two right angles; and when it has got back to OA, its original position, it has travelled over *an angular space equal to four right angles*. The point P has then described a circle, so that the *angular space* round the centre of a circle, or, in fact, round any point, amounts to four right angles.

The meaning of *acute* and *obtuse*, as applied to angles, should be given here.

The importance of the right angle as a *standard angle* should be dwelt upon, and it should be pointed out that *all right angles are equal*. The right angle itself is not a convenient unit, hence its division for practical purposes into ninety equal parts called degrees. The degree is the practical unit, and its further division into minutes and seconds ought to be mentioned. It is rather important that the pupil should have a fairly clear notion of the size of an angle of one degree, and this is a convenient place at which to dwell on the fact that the lengths of the arms of an angle have nothing to do with determining *the size of the angle*. This depends only on the *amount of rotation* which one arm must undergo before it is brought into coincidence with the other, and it will easily be seen that this will be the same for the same angle, whatever the lengths of the arms.

We can now get some information concerning the size of some of the angles of the figures in Section A. For example, in Fig. 6, Section A, we have the angular space round a point taken up by six equal angles. Each of these, therefore, is $\frac{1}{6}$ of a right angle; or in degrees, 60°. Each of these is the angle of an equilateral triangle. We now proceed to demonstrate that *all the angles of an equilateral triangle are equal*, by means of a piece of paper cut to fit one of them; *they are, therefore, together equal to two right angles*. This result suggests the idea that the angles of any triangle may total up to 180°. We therefore take a *scalene* triangle, and also an *isosceles* triangle, and cutting out the angles, place them together to see whether they fill up the *same angular space as two right angles*.

We may experiment in a similar way with quadrilaterals, regular and irregular, and arrive at the corollaries to Euclid i. 32. Numerical exercises could then be given upon these.

It is very important to make clear the meaning of *perpendicular* and *vertical*. A plumb line should be used to obtain the *vertical* direction.

There is no reason why the *unit of circular measure*, the *radian*, should not be defined and explained at this stage. It should be easily understood after the work in connection with Exercise 6, Section A.

If we take a length of the circumference equal to the radius, and draw radii from the extremities of this piece, these radii enclose the *radian* (Fig. 2). Since the radius is contained in the circumference 6·28 times, there will be 6·28 *radians in the angular space round a point*, so that four right angles equal 6·28 radians. One radian is therefore about 57°, which was to be expected from the results of Exercise 6, Section A. It is worth while at this point to note that an arc may be taken to represent an angle, though it is not possible to construct the actual angle from knowledge possessed by the pupil at this stage of his work.

FIG. 2.

PROBLEM 2.—*To construct a right angle at the end of a straight line.*

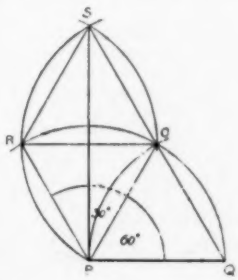


FIG. 3.

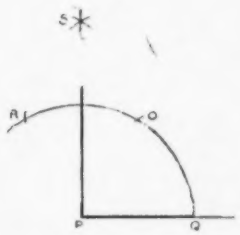


FIG. 4.

This has practically been done already. Refer to Fig. 6, Section A. Repeat this, but do not proceed beyond the third equilateral triangle. Join P to S. (Strengthen the lines PS, PQ.) SPQ is the right angle (Fig. 3).

Note.—It will be found necessary to give now some instruction as to the method of naming angles.

It is very important that we should convince our pupil that the angle SPQ is really a right angle. This can be done without difficulty. (See Fig. 3.)

The reader will perceive that there is practically nothing new in this problem, and that the transition from Section A to Section B is a very simple one. In fact, there is no special

reason for making Problem 2 an independent problem, except the one of convenience. We must next obtain the right angle in the *practical* way—that is, we must repeat the exercise, and omit all unnecessary lines (Fig. 4). It will not be difficult to satisfy the class that the equilateral triangle OPQ need not stand on the whole of the line, and that the point P need not necessarily be at the end. Hence we may erect a perpendicular from any point in a line by this method.

EXERCISE 1.—*Erect perpendiculars, AC, BD, each 1 inch long, at the ends of a line AB, 2 inches long. Join C and D.*

ACBD is a rectangle. The equality of all its angles should be demonstrated. For the purpose of testing right angles, one should be cut out in paper (squared paper would be convenient for the purpose) and given to each pupil. The teacher might use a set square.

The diagonals should be drawn and measured, and it should be shown that the point of intersection O (Fig. 5) is equidistant from the four corners, and a circle should be described round the rectangle.

The four triangles into which the rectangle is divided consist of two pairs of similar triangles, but that they are all equal is not so evident as in the case of the rhombus (Exercise 2, Section A). By using squared paper, however, we can demonstrate

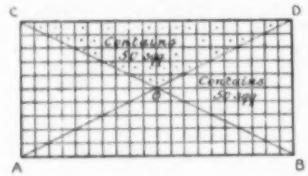


FIG. 5.

satisfactorily that they are equal. Paper divided into inch squares, and these again subdivided into hundredths of a square inch, will be found very useful. The equality or otherwise of the triangles DOC, DOB, which are dissimilar in shape, is ascertained by counting the number of small squares enclosed by each. The rule is to reckon those greater than half a square as whole ones, and to neglect portions less than half. This use of squared paper, to which I should like specially to direct attention, can always be resorted to when we wish to demonstrate the equality of two figures which are not similar in shape; in such cases, of course, the method of superposition will not apply.

EXERCISE 1*a*.—*Repeat Exercise 1, but draw the perpendiculars on opposite sides of AB. Join CD.*

Compare the result with that of Exercise 1. Note that CD bisects AB, and that the two triangles formed are exactly alike.

EXERCISE 1*b*.—*Construct a square on a given line, AB, 2 inches long.*

This is simply Exercise 1 repeated, AC and BD being both equal to AB.

Its diagonals should be drawn and measured, and a circle described about it as in the case of the rectangle. The rhombus, rectangle, and square should be compared; in fact, the figure should be thoroughly investigated in the manner shown in previous exercises. Especially should the diagonal and side be compared as to length. We shall find that the diagonal is 1·42

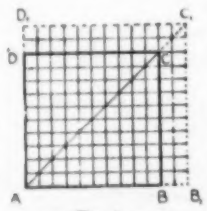


FIG. 6.

(almost) times the side. By using squared paper, as shown in Fig. 6, we can rapidly make a series of squares, and verify the result obtained from the first square in all the others. For instance, in the figure AB is 1 inch, AC is 1·42 inch, AB_1 is 1·2 inch, AC_1 1·7 inch, and $\frac{1{\cdot}7}{1{\cdot}2}$ is 1·416 inch. (Theoretically it ought to be 1·414.)

This constant relation between these two lines should be emphasised, and reference made to a similar constant ratio between the circumference of a circle and its diameter, already obtained in Section A, and numerical exercises given for practice.

It will be easy for the pupils now to copy the figures given below, and to construct from Fig. 7 a cube, and from Fig. 8 a

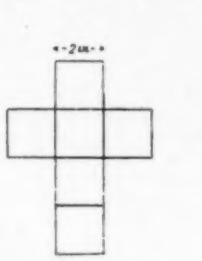


FIG. 7.

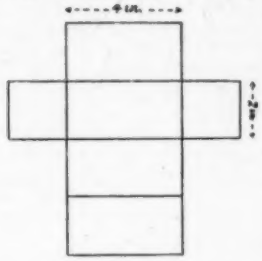


FIG. 8.

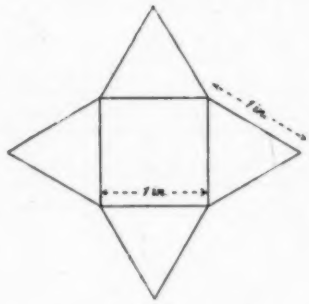


FIG. 9.

square prism, and a square pyramid from Fig. 9. These solids are to be kept in reserve for the solid geometry lessons.

The mensuration of the rectangle, square, and right-angled triangle should be taken here, squared paper of the kind already mentioned being used for the purpose. The rectangle should be taken first, the square being regarded as a special case. The squaring of numbers and the extraction of square roots could be suitably dealt with here, simple cases being actually worked on squared paper.

Such problems as the carpeting of rooms, laying tiles on garden walks, etc., could be made more interesting to beginners by the help of geometry and squared paper, and should certainly be taken in conjunction with this subject. By linking up cognate subjects in this way, much time and labour would be saved, and the result would be that *all* the related subjects would be more clearly grasped by the pupil.

The following series of exercises may now be taken:—

EXERCISE 2.—*To draw a tangent to a circle at a given point on the circumference.*

Attention should be drawn to the fact that only one tangent (touching line) is possible at a point on the circumference. The beginner is not always easily convinced of this, and accurate

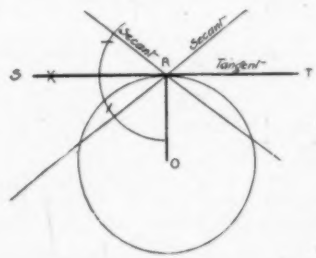


FIG. 10.

work is necessary to show it. Other lines should be drawn through the same point to show that they cut the circle. These lines are known as *secants* (cutting lines).

EXERCISE 2*a*.—*Draw a tangent at each of two given points on the circumference of a circle.*

Produce the tangents till they meet. At first let the points

be fairly near one another, say about 60° apart, and then repeat the problem with the points farther and farther apart, noting the effect on the point of intersection of the tangents.

The properties of the figure formed by the two tangents and the two radii should be investigated in the way already described.

It will be clear from these exercises that when we move our point from the circumference *away from the circle*, it must be possible to draw *two tangents* to the circle. How many can we draw when the point is inside the circle?

EXERCISE 2c.—*Draw three equidistant radii in a circle.* (See Section A.) *Draw tangents at their extremities.*

This gives us the equilateral triangle described about a circle.

EXERCISE 2d.—*Repeat with four equidistant radii, and thus obtain a square about a circle.*

To obtain the radii draw one, erect a perpendicular at the centre of the circle, and produce the lines thus obtained through the centre.

EXERCISE 2e.—*Place a hexagon about a circle, with its sides tangential to the circle.*

It will be evident from these exercises that we could describe any polygon about a circle, if we could only draw the right number of radii in the proper positions.

EXERCISE 3.—*Construct a quadrant* (quarter of a circle). Complete the circle, and obtain four quadrants.

EXERCISE 3a.—*Trisect the quadrant;* hence obtain three angles each 30°.

EXERCISE 3b.—*Trisect all the four quadrants of Exercise 3, and then inscribe in the circle a twelve-sided regular polygon* (dodecagon).

Section C.—The Isosceles Triangle.

PROBLEM 3.—*Construct an isosceles triangle on a given line 2 inches long, the equal sides being 2½ inches.*

This should present no difficulty whatever. It is practically Problem 1 repeated.

EXERCISE 1.—The following would make an interesting exercise at this juncture:—

Describe on the same side of a line 2 inches long—

(a) *An equilateral triangle.*
(b) *An isosceles triangle, with sides 2½ inches long.*
(c) *An isosceles triangle, with sides 1½ inches long.*

Discuss the position of the apex of the isosceles triangles with reference to that of the equilateral triangles.

EXERCISE 2.—*Given the angle at the apex of an isosceles triangle, and the length of the equal sides, construct the isosceles triangle.*

Note.—Make the apical angle 60° and 90°, and observe the result in each case.

The following form also an interesting series because of their application to later problems.

EXERCISE 3.—*On both sides of a line construct similar isosceles triangles.*

EXERCISE 3a.—*On both sides of a line construct dissimilar isosceles triangles.*

Note the figures produced in each case. Join the apexes. Demonstrate—

(a) That the diagonals bisect each other.
(b) That they bisect the apical angles of the isosceles triangles.
(c) That they cross each other at right angles.

We have in these two problems the key to the solution of three important problems:—

(1) The bisection of a line.
(2) The bisection of an angle.
(3) The construction of a right angle (second case).

These will all receive attention in their proper places.

EXERCISE 3b.—*Describe dissimilar isosceles triangles on the same side of a line. Join the apexes.*

Note whether the joining line and the base stand in the same relation to each other and the vertical angles as in Exercise 3a.

The following exercises may also be taken in this connection.

EXERCISE 4.—*Find a series of points—say six—each of which shall be equidistant from two given points.*

Notice that they all lie on a straight line, which is the line bisecting the line joining the given points at right angles. This line is the *locus* of all the points equidistant from two fixed points.

Define locus, and give other simple instances. The circle is a good example from figures already dealt with.

EXERCISE 4a.—*Describe a circle of radius 1 inch to pass through two given points.*

Could more than one circle be drawn? What is the smallest radius such a circle could have? What is the largest?

This is, of course, only Exercise 4 in another form.

EXERCISE 4c.—*Find a point in a given line XY which shall be equidistant from two other points P and Q.*

This problem presents many interesting features. First, the method of attacking it is worth noting. We suppose a point found, and see what sort of construction would lead to such a result. It is clear that the point required will lie on the line found in Exercise 4. But the point must also lie in XY; therefore it is where these intersect. Another reason for introducing this exercise is that it admits of several cases, depending upon the position of the points P and Q with reference to XY, and to each other. All the possible cases should be investigated, and the failing cases also examined. This would form a valuable exercise, especially for beginners who are rather older than the average. In this particular example the teacher should first select a case that is sure to yield a satisfactory solution.

The cases worth investigating are:—

(a) When P and Q are both outside the line XY; and—
  (1) On the same side.
  (2) On opposite sides.
(b) When one point is in the line.
(c) When both points are in the line.
(d) When they are in a line at right angles to XY—
  (1) One in the line and one out.
  (2) Both on same side.
  (3) One on either side of XY.
(e) When they are both the same distance from XY.

The following additional exercises serve to impress upon the pupils the fact that when the circumferential extremities of two radii are joined, an isosceles triangle results—a simple fact that is not always grasped by beginners.

(a) *Describe a circle, radius 1 inch. Draw any chord AB. Join A and B to the centre.* What kind of triangle results?

(b) *Make another triangle like A and B in the same circle, with its apex at O the centre.*

(c) *Draw any two diameters in a circle. Join the extremities, so as to give two isosceles triangles—*

(1) *So as to obtain two similar ones.*
(2) *So as to obtain two dissimilar ones.*

When would they all be alike?

(d) *Draw the diameters at right angles.*

What figures are produced in (c) and (d) by joining the extremities of the diameters?

These exercises are not, of course, intended to be exhaustive by any means, and teachers should frame others for practice, taking care, however, that they do not involve anything which is not dealt with in the sections taken. It will be found that, as a rule, the exercises chosen here illustrate some interesting geometrical or arithmetical truth, and most of them have also a direct bearing on those that follow, and could not, therefore, be easily omitted from the course. Problems which merely serve as exercises for practice are not, as a rule, given in this scheme of instruction.

PHYSICAL TRAINING.

A PROGRESSIVE COURSE FOR ELEMENTARY SCHOOLS.

BY H. RIPPON-SEYMOUR, A.C.,

Chief Instructor, George Watson's College, Edinburgh; Member International Congress of Physical Education, Paris, 1900; Author of "Physical Training," etc.

NOTE.—The military commands given throughout this course are almost exactly in accordance with the commands in the *Infantry Training, 1902*, and the *Model Course*, except where experience has shown a modification desirable. The alternative command will generally be shown in a footnote, and the teacher is at liberty to adopt either.

SEVENTH LESSON.

Dumb-bell and Physical Exercises, etc.

(The words of command are in heavy type.)

DUMB-BELL EXERCISE, No. 7.

77. "**Seventh exercise—One.**"—Lunge as before described (24) with the right foot, but to the right front"—namely, at an angle of 45 degrees from the front—and at the same time raise both hands above the head, about ten inches apart, the finger-nails to the front, arms straight, head well up (Fig. 1).

"**Two.**"—Bend forward, and lower both hands towards the floor without touching it, the back well bent, the breast resting on the right thigh, the legs kept in the correct position of "Lunge." (Fig. 2.)

Fig. 1.

"**Three.**"—Keep the legs in the same position, raise the arms and body, and resume the "first" position.

"**Four.**"—With arms straight over the head, reverse the lunge as described in 58, turning to the left.

"**Five.**"—Bend down as described in "Two," the breast now resting on the *left* thigh.

"**Six.**"—Raise the arms and body, and resume the "fourth" position.

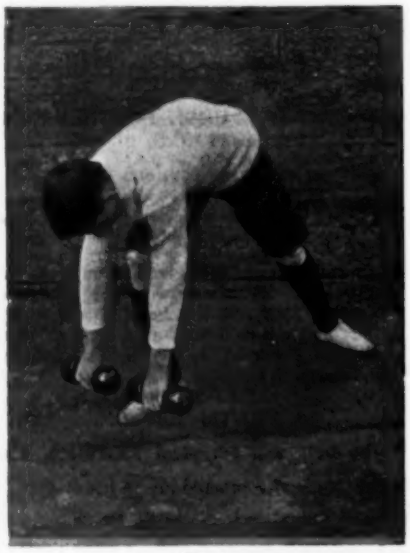


Fig. 2.

"**Seven.**"—Again reverse the lunge, turning to the right, and keep the arms above the head. The pupil should now be in the first position.

"**Eight.**"—Recover to "Attention," bringing back the right foot, and at the same time throw the hands well back and downwards.

Repeat these movements with the left foot forward to the "*left*-front," substituting "left" for "right" in the foregoing instructions, and *vice versâ*.

DUMB-BELL EXERCISE, No. 8.

78. This exercise (which is practically a combination of several movements in the other dumb-bell and physical exercises) is somewhat difficult both for teacher and pupil. It has sixteen different, or nearly different, movements, and at first, in order to prevent confusion, instead of numbers, explanatory words, such as "bend," "swing," "jump," etc., may be used: for example, the numbers 13, 14, 15, and 16 may be well substituted by the words "bend," "jump," "swing," and "jump" respectively, which practically explain the movements to be performed.

This (eighth) exercise will conclude the list of dumb-bell exercises.

"**Eighth exercise—One.**"—Raise both hands to the front above the head, arms straight, back of the hands outwards and ten inches apart.

"**Two.**"—Throw the hands smartly backwards over the shoulders and downwards, and continuing the circular movement forward and upward, resume the first position.

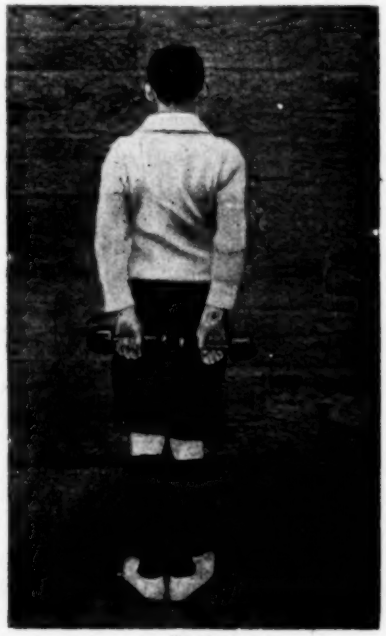


Fig. 3.

"**Three.**"—Repeat as in "Two."

"**Four.**"—Throw the hands backward as before, but instead of completing the circle, bring them in behind the back, with straight arms. The hands or dumb-bells may be allowed to touch, if desired. (Fig. 3.)

"**Five.**"—Raise the hands from their position behind the back, and place them above the shoulders with bent arms—as in the first position of the first dumb-bell exercise (47).

"**Six.**"—Lunge to the right, arms in horizontal line, as shown in the fourth exercise (Fig. 3, fourth lesson).

"**Seven.**"—Recover the right foot, and resume the position described above in "Five."

"**Eight.**"—Lunge to the left, arms in horizontal line.

"**Nine.**"—Recover the left foot, resuming "Fifth Position."

"**Ten.**"—Raise the hands from the shoulders, and push them smartly over the head, as described in "One," at the same time rising on the toes (heels raise).

"**Eleven.**"—Resume previous (or "Fifth") position.

"**Twelve.**"—Repeat the movement described above in "Ten."

"**Thirteen**" (or "**Bend**").—Keep the heels raised and the arms straight over the head; bend the knees as described in (26). (Fig. 4.)

FIG. 4.

"**Fourteen**" (or "**Jump**").—Spring smartly upward, as high as possible, and alight with the feet twelve inches apart, arms still being straight above the head.

"**Fifteen**" (or "**Swing**").—Bend the body well forward from the hips, and swing the arms and hands downward and through the legs, bending the knees slightly in so doing.

"**Sixteen**" (or "**Jump**").—Swing the arms and hands over the head, straighten the body, and at the same time jump upwards, alighting with the heels closed as at "Attention," the arms meanwhile continuing the swing over the head and downward to the sides.

PHYSICAL EXERCISES.

79. "**Turning the Body—One.**"—Keeping the legs straight and feet as at "Attention," turn the head and body from the hips upward slowly to the right as far as possible.

"**Two.**"—Turn slowly to the front.

"**Three.**"—Turn, as directed in "One," slowly to the left.

"**Four.**"—Turn slowly to the front.

This movement may be performed in any one of the "positions" described, such as "Hands on Hips," "Hands behind or above the Head," or "Arms folded behind," etc.

The following exercises are suitable only for indoor use, or on a clean wooden floor if outside; and for girls only when in proper gymnastic costume.

To place the class in position for these exercises, the following words of command are necessary:—

80. "**Class—Sit.**"—Bend the knees forward, and place the hands on the floor, the fingers in line with, or even slightly behind, the line of the heels.

"**Two.**"—Push the feet forward and sit down, with the legs straight and together, the toes pointed, and the hands on hips. Practice will soon enable every pupil to perform this movement with ease.

Lowering and Raising the Body.

To be performed whilst in sitting position as above.

81. "**Lower.**"—Keeping the back straight and head erect, lower the body slowly to the floor, and lie down, hands on hips.

"**Raise.**"—Resume the sitting position. Repeat not more than six or eight times.

If any difficulty is experienced in performing this movement (which is too advanced for pupils under the age of twelve), one rank may be directed to "Turn-about," and, facing the rank about to go through the exercise, stoop forward and hold their feet, thus preventing the feet from leaving the floor, and rendering the exercise easier.

"**Attention.**"—The sitting rank will place their hands on the floor near the thighs, draw the feet under them, and stand smartly up.

Raising and Lowering the Legs.

To be performed from the lying position as above.

82. "**Right Leg—Raise.**"—Keeping the leg straight and the toe pointed, the hands on the hips or behind the head, slowly raise it to a vertical position.

"**Lower.**"—Lower the leg slowly to the floor.

"**Left Leg—Raise.**"—As described for the right leg.

"**Lower.**"—As before.

After some weeks' practice raising and lowering one leg at a time, the pupils may be exercised with both together. The words of command are as follows:—

83. "**The Legs—Raise.**"—Raise both legs straight and slowly to the vertical position.

"**Lower.**"—Lower slowly to the floor, no noise being made with the heels.

Repeat six times, and on completion of the exercise give the command,—

"**Attention.**"—The pupils will first assume the sitting position, and then spring to "Attention," as described above.

The author will be pleased to answer in these columns questions of general interest on drill and physical training. Letters should be addressed to the **Author, care of the Editor,** *and must enclose the coupon on back page of cover.*

OUR ILLUSTRATED GEOGRAPHICAL NOTEBOOK.

ENGLISH CANALS AND CHEAP TRANSPORT.

IN these days of stern commercial competition, when the foreigner is even within our gates encroaching upon the home markets, the demand for cheap transport becomes of increasing national importance. The

First English Canal

to be opened to through traffic was the Bridgewater Canal, from Manchester to Runcorn, in 1772. The advantages offered by the new waterway were so obvious that success was assured from the commencement. Hitherto goods passed between Liverpool and Manchester by road at the rate of 40s. per ton; by means of the uncertain Mersey and Irwell navigation it had been 12s. per ton; but by the Bridgewater Canal the cost was reduced to 6s. During the next twenty-eight years, and especially in the period 1790–94, canal construction attracted so much attention that no fewer than

2,000 miles of canals

had been completed by the end of the eighteenth century. Ill-judged speculation was doubtless the source of many schemes, yet some were of immense importance. The most serious impediment to canal development at this time was the lack of uniformity in rates and tolls. But the advantages far outweighed any defects, and the fortunate holders of canal stock saw their shares rise in value, in some instances from £140 (nominal value) to £1,820, with a dividend of £124.

The year 1825 marked the opening of the Stockton and Darlington Railway, and in the next fifteen years quite 3,000 miles of railroad were projected and largely in course of construction.

The Canal Companies failed

to realise the seriousness of railway competition. They

maintained their heavy tolls, which kept up their dividends only for a time, whereas the adoption of cheaper rates would have been a set-off against the speed advantage of the railway, and would have given the canal companies an opportunity of sharing in the immense increase that has taken place in the inland traffic of the country. In face of the new competition canal profits rapidly dwindled, and in many cases the companies were only too glad to dispose of their properties to the railway companies, whose interest it was to do all in their power to check the development of a rival carrying-power. In a period of three years alone (1845–48) railway companies became possessed of quite 1,000 miles of waterways, thus indicating a definite policy directed to

checking inland navigation.

At the present time, out of a total length of 3,520 miles of inland navigation in England and Wales, over 1,200 miles are owned by railway companies. At first glance these

figures do not by any means convey an idea of the power of the railways. The railway-owned canals are usually so situated as to impede through communication between the more distant industrial centres. From Liverpool to Hull is an excellent example in this respect: the through route is 150 miles, of which the railway-owned Huddersfield and Ashton section is less than thirty miles in length. In this case

railway domination of the canals

between the Mersey and the Humber is secured by the possession of a section only one-fifth of the whole distance, but upon which the railway company may charge such restrictive rates as to drive freights to the railway.

For more than half a century English canals have been in a state of stagnation; about 150 miles have been converted into railways; and nearly 300 miles have become derelict. During this long period canal construction has been almost at a complete standstill.

Our railways have imported vital energy into our national affairs, they have multiplied the volume of trade, and they have contributed largely to our happiness and prosperity. But our traders groan under

ruinous railway rates,

which hamper and restrict trade, and in many cases make it an impossibility to compete with the foreigner.

Other nations are extending and improving their canal systems, and it is high time the subject received attention in our own country. It is not difficult to enumerate the chief points to be aimed at in

canal reform.

In the first place, the abolition of railway control is absolutely essential. The unification of interests and the consolidation of management would doubtless make for smoothness and economy in working. The main channels require deepening and widening; and mechanical traction instead of horse haulage seems to be of pressing importance.

A Canal Traffic Bill was before Parliament last year, but was withdrawn. One of its chief features was a provision for the purchase and management of canals and navigable rivers by public canal trusts. The matter is of so great importance that the Bill will certainly make its appearance again.

If our inland industries in particular are to hold their own, improved access from

the Midlands to the sea

becomes a vital necessity. Already important Staffordshire industries have been removed to the coast, to avoid the arbitrary imposts of the railway companies. A ship-canal from the Midlands to the sea is naturally out of the question, but competent engineers assert that the Birmingham and Worcester Canal could be improved to allow vessels carrying 250 tons to go straight from the Bristol Channel to Birmingham *viâ* the river Severn and the canal.

By means of the accompanying map it will be possible to trace

the chief canals,

although it is almost an impossibility to even briefly enumerate all the different systems. The chief are:—

I. Connecting the Mersey and the Humber by means of the rivers Irwell and Calder.
   1. From Manchester to the Humber *viâ* Huddersfield.
   2. From Manchester to the Humber *viâ* Rochdale, Halifax, and Wakefield.
   3. From Liverpool to the Humber *viâ* Blackburn, Burnley, and Leeds.

II. The Mersey and the Trent are joined by numerous waterways that intersect the Potteries *viâ* Nottingham, Burton, Stoke-on-Trent, and Runcorn.

III. The Birmingham and Black Country district, by means of an intricate network of canals, is connected with the Severn at Worcester, the Trent *viâ* Lichfield and Tamworth, and with the Oxford Canal *viâ* Warwick and Napton.

IV. The Thames and Severn are connected—
1. By the Thames and Severn Canal *viâ* Lechlade and Stroud;
2. By the Kennet and Avon Canal *viâ* Bath and Bristol.

The Thames and Trent are connected by means of the Grand Junction and the Grand Union Canals *viâ* Watford, Wolverton, and Leicester.

Notwithstanding railway competition, a few of our canal companies are now showing that skill and energy and progressiveness can be made to produce dividends. In this respect the Aire and Calder navigation is a good example; and what it is possible to effect in one case is probably well within the reach of all if the canal-reform problem were tackled with determination.

This present article should not close without reference to

the Manchester Ship Canal.

This huge undertaking has by its enormous cost demonstrated the impracticability of constructing in this country ship-canals for bringing ocean-going steamers beyond towns a few miles from the coast.

The Manchester Ship Canal has a length of 35 miles; it is 170 feet wide at the top, and 120 feet wide at the bottom. It commences at Manchester, and passes *viâ* Barton and Irlam to Warrington, thence to Runcorn; keeping parallel to the river Mersey, it passes through Ellesmere Port to Eastham, where it enters the Mersey. The canal is connected with all the chief canal systems of the Midlands and the north.

It was constructed at a cost of over £11,000,000; the total capital of the company is over £15,000,000. The profits amount to about £150,000 per annum. It will readily be seen how small is the return upon the capital invested, ignoring altogether the long period when no profit was returned.

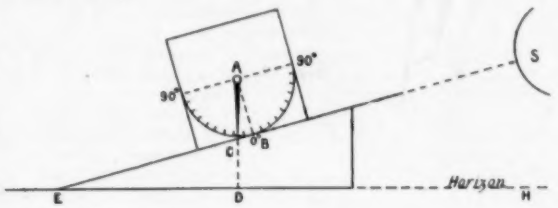
SIMPLE METHOD OF ASCERTAINING THE ALTITUDE OF THE SUN.

As a subject of nature knowledge, and especially with a view to the explanation of one of the prime factors of the change of the seasons, the varying altitude of the sun should be observed by pupils. A certain degree of precision is obtainable by a simple piece of apparatus mentioned by Wilbur S. Jackson of Chicago in his *Nature Study for Common Schools*. It consists of a strip of wood two feet long and two inches in width, to one end of which is fastened an upright strip of same width and four inches in height. The second part of the apparatus is constructed thus:—A piece of cardboard six inches square, with a semicircle described upon it and graduated, is fastened to a piece of wood of same size and one-half inch thick. At the centre of the circle swings on an axis or pivot a tin or brass pointer three inches long. This will always hang down when the dial is upright. Fasten a strip of wood, half an inch square and eighteen inches long, to the base of the dial-board. (One foot only is required for the latitude of Chicago.)

Now set the apparatus so that the base-strip will be horizontal and the pointer hanging downwards. The pointer will indicate zero. When the base-strip is raised, the number of degrees it is from the horizontal will be shown by the pointer.

To ascertain the altitude of the sun, at noon place the strip of wood with the upright in a horizontal position on a north and south line. (It is helpful to have a brass rod let into the floor to indicate this direction.) At the extreme edge of the shadow cast by the upright place one end of the base-stick carrying the dial, and rest the other on the top of the upright. The sun's altitude will be indicated by the pointer.

To show that the angle through which the pointer has swung is equal to the angular distance of the sun above the horizon, it is necessary to prove that angle BAC is equal to angle SEH. Produce AC to D. Angle ABC equals angle CDE, each being a right angle. Angle ACB equals angle ECD (I. 15). Therefore angle BAC equals angle SEH (I. 32, cor.).



If throughout the year a weekly record is kept by the pupils, and then the total graphically represented, a valuable training will be afforded, and data will be collected as a basis for interesting problems.

NOTES AND JOTTINGS.

THE CHILDHOOD SOCIETY.—At a meeting of this society, held on 11th May at 7 St. James's Square, the president, Earl Egerton of Tatton, presided, and among those present were the Duchess of Buckingham and Chandos, the Countess of Albemarle, Julia, Marchioness of Tweeddale, Sir James Crichton-Browne, M.D., and Mr. E. W. Brabrook, C.B. A resolution was carried declaring it to be desirable that the Elementary Education of Defective and Epileptic Children Act, 1899, should be compulsory on educational authorities; that special training should be given at one or more training colleges for teachers who wish to qualify for the care of defective children; and that the Government should be requested to institute an inquiry into the best means of dealing with such children in after-life, and for determining the authority to be entrusted with that duty.

HOLIDAY NOTES.—In response to frequent requests from our readers asking for advice in the selection of holiday resorts which are "far from the madding crowd," we propose to devote a column or two in our July issue to short descriptions of suitable but little known places. We shall be glad to receive at the earliest possible date in June short notes on any places which any of our readers have visited, and would like to recommend to their fellow-readers. In order to supply as wide a variety as possible, we ask that these contributions may not exceed ten or twelve lines; and they should neither deal with popular resorts, nor be of the nature of advertisements. The places of interest in the neighbourhood, and the nature of the attractiveness of the place itself, should be indicated.

HOLIDAY COURSE IN SWITZERLAND.—Any of our lady friends who would like to follow the holiday course at Neuchâtel, but are diffident about travelling alone, will be glad to hear that Miss Walter, one of the Inspectors of the Board of Education, has arranged a party to visit Switzerland, including the Bernese Oberland, and that the trip may be worked in connection with the course at Neuchâtel, special arrangements having been obtained from the university. Full particulars may be obtained from Miss Walter, 38 Woodberry Grove, Finsbury Park, London, N.

DEMOOR'S ILLUSION.—This is an illusion of the muscular sense first investigated by Demoor, a doctor in Brussels. If you take two bodies of the same weight but of different size—for example, a ball of wood and a ball of iron, or a box filled with sand and a smaller one of the same pattern containing shot—and ask any one to tell you which is the heavier, he will invariably say that the smaller one is the heavier. M. Claparède of Geneva has found, as the result of a large number of experiments, that normal children, even if their education has been altogether neglected, make this mistake, whereas the illusion does not occur in those who are mentally deficient. This result seems to be important to teachers, as it appears to offer a ready test by which backwardness due to want of teaching may be distinguished from that which is due to cerebral weakness.

The Practical Infant-School Teacher.

OUR MODEL INFANTS' SCHOOLS.

XV. VIRGINIA ROAD, BETHNAL GREEN.

HOW many readers of the *Practical Teacher* have any definite and accurate knowledge of this part of London? To most it is vaguely located as a part of the East End, where the alien immigrant finds a home and the outcast Hebrew thrives; where poverty, vice, squalor, and misery are the permanent background to a picture of struggling humanity, impossible to behold in any other part of the world. To look for a model school in such a locality would seem to the casual observer an act somewhat lacking in judgment. But the East End of the unfettered imagination differs very much from the East End of reality, and requires personal knowledge gained on the spot to appreciate fully the various localities, differing from each other almost as much as Park Lane differs from Petticoat Lane, yet forming the units of which this vast and populous region consists. It is here that the elementary schools, and the teachers connected with them, are doing a work impossible in other districts; for it is here that nearly all that is joyous and pleasurable in the lives of the children originates in or is connected with the school, and the first touches of sympathy and friendship are those existing between teachers and scholars. Of course the work of the teacher is more difficult and often less pleasant than that carried out under more favourable conditions; but given an enthusiasm for the work (and absence of this enthusiasm means failure), the fruit of one's labour is more readily recognisable, and stimulus is gained by obvious success, much more frequently than in schools in better districts. There are many teachers in East End schools to-day who would be very unwilling to exchange places with those who consider themselves the special favourites of fortune in the location of their school.

Virginia Road School is within a stone's-throw of Shoreditch Church, and approached from this direction is not distinguishable from its generally squalid surroundings; but in the opposite direction it is flanked by a block of model dwellings, which has completely transformed this part of the district, and is, let us hope, indicative of further extensive transformations of a similar kind. Miss Barnett is the headmistress, and is ably supported by a staff of six assistants. A very short time in the school is sufficient to impress one with the keenness, enthusiasm, and love for the work which is everywhere manifest, the complete grasp of all details, and the desire to make the school a real educative influence of the best kind.

The average attendance is about four hundred, and the school is organised in two sections, consisting of seven classes. The lower section consists of three classes, the lowest containing children under four years, and the other two those of an average age of four and a half years. The upper section consists of four classes—namely, Standard I. children, (*a*) and (*b*), and two classes containing children with an average age of five and a half years. The feature of the school is the adoption of Miss Dale's method of teaching reading, and the co-ordination of all other work with this. Miss Barnett gladly acknowledges her indebtedness to Miss Dale, and her books *On the Teaching of English Reading* and *Further Notes on the Teaching of English Reading*, and has found it possible, by making a few alterations and variations, to use the method in large classes with the most satisfactory results. The testimony of H.M. Inspector is sufficient evidence of this. In the last report he says: "This is a most interesting school. New methods are intelligently employed, and the children's imagination and intelligence are carefully fostered, while individual effort and self-reliance are elicited and encouraged. The headmistress deserves the greatest credit, and she is thoroughly well supported by the staff."

If any readers of the *Practical Teacher* have found the teaching of reading irksome, and the progress made by the children painfully slow, they cannot do better than make themselves acquainted with Miss Dale's method. There is no doubt that in the hands of a skilful teacher it will prove a more effective method for teaching this subject than any previously attempted. It is based on sound principles, is most interesting to teacher and scholar, and forms a splendid foundation on which so much of the other work depends. The following points are from Miss Dale's book, and sufficiently indicate the chief features of the system.

I.—*The Child.*

1. Children unconsciously reflect the point of view of the teacher; hence the importance of a correct attitude towards the teaching of the mother tongue on the part of the latter.

2. Children are anxious to be interested, and willing to help if allowed to share in the work; hence the necessity of supplying them with subjects of interest, and giving them opportunities for *doing*. They love adventure, desire to make discoveries for themselves, love colour, delight in pictures. Their vivid imagination necessitates that the work shall be as living as possible.

3. They are interested in each other, so follow eagerly the work of those who are asked to help with the closest attention. This help is always obtainable without any interference with the working of a class, as children delight in sharing the responsibility of maintaining order in their classroom.

II.—*The Spoken Language.*

1. It is interesting to notice the natural order in which children acquire a spoken language. They hear, and try to utter, first sounds, then words in connection with objects, and then gain the power of speaking in sentences.

The continuation of this natural order forms the first stage of the system. Children have interesting things to talk and sing about, and are encouraged to talk, care being given to correct pronunciation and musical articulation. Simple nature lessons, picture talks, stories of animals, fairy tales, and nursery rhymes furnish ample material.

No letters or symbols are used during the early stages; there is therefore no writing. The children make chalk, brush, or sand drawings of the things talked about, having whenever possible the actual things to draw from.

In the second stage the children are led to discover the sounds of the spoken language—that is, initial, final, and middle sounds. In the third stage these are compared, and in the fourth stage the method of producing them is noticed.

2. Signs for sounds. The introduction to symbols does

not follow till the earlier stages have been thoroughly completed, and the method of doing this is clearly shown in the *Further Notes*. Connected with this stage are the embroidery cards, and the use of the tabulating frame and box of symbols.

3. Printing the symbols follows, the simplest printed forms being taken and the work done with coloured chalks. Later it is easy to turn the printed characters by a slight change in the printed forms into ordinary written forms—for example, *men* becomes *men*.

The books prepared for class use in the different stages are models of reading books, and enable the teaching to proceed on the lines so admirably set out in the two books for teachers. The above is a very bare outline of the work that is done, but if it creates sufficient interest in the subject to induce further investigation, it will have served its purpose.

The following is a brief summary of the work done in the upper section of the school:—

In connection with the reading, word building is taken; also the printing of the letters forming the word, followed by the formation of sentences containing the word. For example, the word "nest," say, is a new word occurring in the next reading lesson. A little story is told to introduce the word. The sound is carefully noted, and suggestions are obtained from the children about its composition. Then volunteers are called for to build up the word in the special frame for this purpose; the formation of the letters is noticed and imitated by the children with the index finger in the air. The word is then printed, and in this connection it is important to remember that children, if properly trained, can use the left hand as well as the right. This fact is utilised in the above school, and the printing is done first with one hand, then with the other. Then another word—for example, "rest" or "chest"—is introduced, and the same process repeated. Afterwards the children reproduce in a small sketch, quite spontaneously, a picture story to illustrate the word. The illustrations will make this clear.

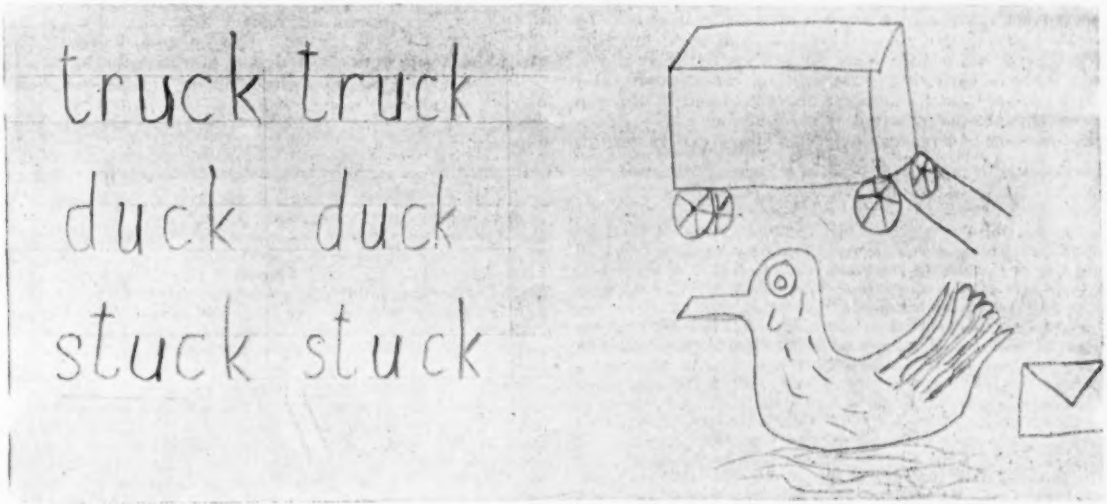
illustrate, a complete story being told by the illustration. Written composition is found to gain very considerably by postponement to a later stage when preceded by such practice as is outlined here.

The teaching of numbers and their use follows the lines indicated by H.M. Inspector for the district, and is taken generally by nearly all the neighbouring schools.

Two short geography lessons are given weekly in Standard I.; and in addition to these, lessons are given on any geographical terms mentioned in the reading books—for example, rill, pond, hill, valley.

Conversational lessons are taken on any countries mentioned, and on the customs of the people who live in them, together with other striking features connected with them. For example, Holland is mentioned in a reading lesson; following this is a talk about Holland, the general appearance of the country, as illustrated by a few landscapes, the character of its people, their simplicity, perseverance, cleanliness, etc., and so for other countries. Any models required are, as a rule, made by the children.

A nature lesson or other talk is given every day. Great interest is shown in these by the children, and even by the parents. The lessons are chosen with regard to the season, and many of the illustrations are brought by the children. For one lesson a frog was wanted, and this was obtained by a boy's uncle, who went to Epping Forest for the purpose. Another boy's father lent his fishing tackle for illustrating a lesson. Lessons are also taken from the reading books. During my visit, just before the Christmas vacation, I heard a delighted talk about Santa Claus, and saw a little drama performed in which, first, a little girl went to sleep, and at seven o'clock, indicated by the class clapping their hands seven times, woke up to find Santa Claus had brought her a doll; the boys then had their turn, and one little fellow awoke to find Santa Claus had left him a drum. These presents were talked about, and the drum pictorially represented. Following this was a game in which two of the children went shopping on Christmas Eve, others acting as



Other noteworthy points are the silent reading, and the dramatising of incidents in the readers, by means of games taken about once a week.

The writing lessons include dictation, transcription, and composition. No slates are used, but throughout the school drawing boards (brown millboards) or sheets of brown paper with coloured chalks are found to be excellent substitutes. These are further supplemented by printing and writing books, which are an integral part of the Dale system. The earliest stages of composition consist of pictorial efforts to express the ideas formed by the children as to the use and meaning of words. As a still further development, a "party" of words is given to print and

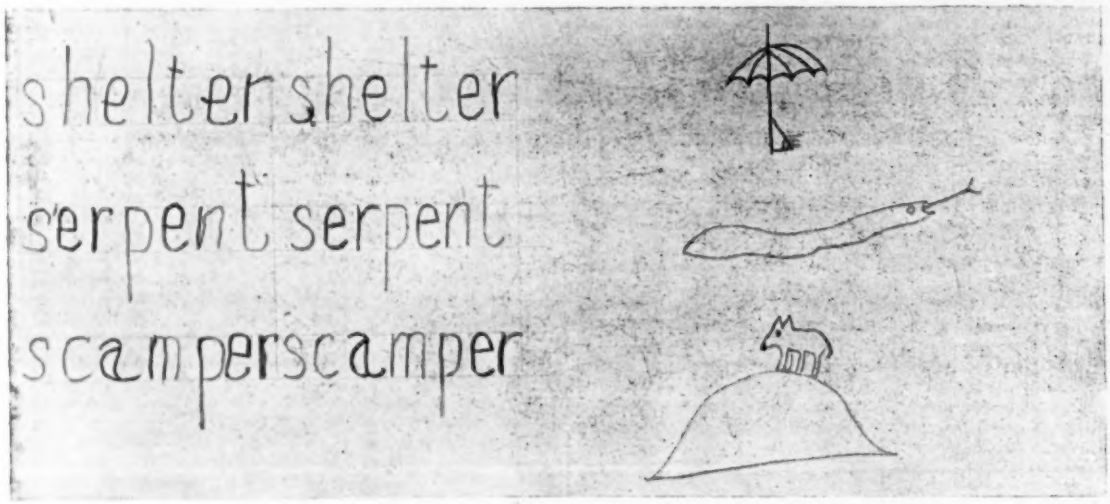
shopkeepers, and the remainder assisting by means of appropriate songs.

At the same time Standard I. were busy with the preparation of a Christmas card for mother. As Miss Barnett pointed out, the children have so much done for them in every way by others, that it is a good thing they should do a little *for* others, and thus realise that there is as much pleasure in giving as in receiving. For this purpose, gilt-edged correspondence cards were provided, and on each was painted in water-colour a little spray, together with the words, "A Happy Christmas." When finished, these were placed in envelopes, and addressed by the children to their parents. Similar work was done in the next class, but this

time in chalk, each child being provided with a picture of a robin, which was reproduced, and embellished by the same sentiment.

Stories, songs, and recitations are specially chosen, often specially written, to illustrate the nature or other lessons, and the expression lessons comprise freearm drawing, clay modelling, brush drawing. Free chalk drawing is practised every lesson, the others once a day. As a rule the brush-work is done from natural objects, but in winter, when these are difficult to obtain, pressed specimens are used.

with number, graduated lessons are taken every day, but necessarily nearly the whole work is done by means of conversational lessons. These are taken daily, and are on every subject possible for this stage of the child mind. They are illustrated lavishly by the teacher, and the illustrations are placed on the walls of the classroom, to serve as a reminder and for revision of the lesson. They are followed by songs, stories, and recitations, all carefully selected for the purpose, also by games played every day by way of illustration, while the children provide their own illustrations by means



In the lower section the work is less definite, and is intended to be a preparation for work in the upper section. Thus, in the reading, no letters are taught in the baby room. Here the chief care is to get the children to notice, how to speak correctly, and all the work is directed to this end. In the other two classes, sounds, symbols, and word building are taught in accordance with the scheme outlined above. Again, there is no writing in this section. Free drawing and graded lessons in mass drawing are taken, and in the top class of this section printing is taught when the children begin to learn the signs for the spoken language. In dealing of sandwork, and again in the top class by means of brush-work and clay modelling.

The chief point that strikes a visitor is the absolute necessity for just the right kind of teacher for this work, as without this supreme fitness the day must be wearisome alike to teacher and scholar. Having seen, however, how easily the whole work proceeds, and how soundly the foundations are laid by the methods adopted, and so excellently carried out in this school, one feels that educationally we are moving fast along right lines, and that there is much hope for the future.

TOLSTOY ON EDUCATION.

THE Russian philosopher has many admirers among the teachers of this country; and although we feel that he is inclined, like all reformers, to indulge in extremes, yet we feel that his words always supply much food for thought. One of his near relatives has recently asked for his opinions on the subject of education, and his reply is to the effect that it is advisable to teach children as little as possible. His view is that there is far less danger in leaving children ignorant of many things than in instructing them incorrectly or superficially, which is often the case when children are instructed by their mothers, whose knowledge is commonly not deep enough. When that is the case the children cannot properly digest the instruction that they receive, and become disgusted with study. The child, like the adult, will retain properly only that which he has learned with pleasure. If his lessons offer no pleasure, they become a forced work, and serve only to make him grow up stupid. Tolstoy feels this so strongly that he says: "I swear to you that I write these lines because they are of the highest importance."

In reply to the questions of how a child should employ his time if he is not studying, and whether he should be allowed to play in the street and learn its bad ways, he says that for aristocratic and well to-do families this objection to his suggestion is not without weight. "But," he asks, "is it really necessary to accustom children to a life of lordly idleness, and to let them believe that all their needs are to be satisfied without their taking part in the work that is going on around them?"

Tolstoy then contends that the first condition of a good education is to make children understand that all the things they require to satisfy their wants do not fall down from heaven, but are produced by the work of other people. It will be far more profitable for children to learn to black their own boots, etc., than to master foreign languages, history, etc. In this matter Tolstoy merely repeats the precepts of J. J. Rousseau, but he adds in connection with the method of setting children to do this work for themselves: "The chief obstacle in the way of this teaching lies in the fact that children do voluntarily only those things which they see their parents do. So I beg you to take this task upon yourself. From the very first month you will be happy, and the children will be still more pleased. Believe me, under these conditions alone can there be any moral education or any moral conception of the fact that all men are brothers.

"Children can quite understand that adults who support their families may be exempt from those cares which would hinder them in their work. But when they see other people do for them what they should have been able to do for themselves, they conclude that men are divided into two classes—masters and slaves, and you talk to them in vain about fraternity, for all the conditions of their life, from the moment they wake up to the moment they go to bed, teach them the contrary. The child ceases to believe in what his elders preach to him on the subject of morality. In his inmost soul he feels that all their words are full of deceit; he ceases to believe in what his parents and masters say, and ends by believing that the whole moral law has nothing in it."

In conclusion, Tolstoy pleads that children should be taught never to dread ridicule, for according to him nine-tenths of our bad actions spring from the dread of appearing ridiculous if we abstained from doing them. But we might add that the teacher should show that bad actions are objects of ridicule, and that the pupil who acts rightly should be immune from it. If this were only premised, then the fear of ridicule would have a deterring effect on those who had a tendency for evil.

OUR TUTORIAL SECTION

OUR PUPIL TEACHERS' AND SCHOLARSHIP COURSE.

BY ARTHUR T. FLUX,

Principal of the Belvedere Pupil Teachers' Centre, First on Scholarship List; Author of "Scholarship School Management," "Building of the British Empire," etc.

NEW SCHOLARSHIP COURSE FOR 1903.

Sixth Month—June.

(*N.B.*—I should be glad if students who intend to follow this course regularly would send their names and addresses to me.)

Work for the Month.

1. *Reading.*—*Esmond*, chaps. ix.-xvi. General reading must not be neglected.

2. *Repetition.*—Continue systematic oral practice.

3. *Teaching.*—Chap. vi., *Scholarship School Management:* Writing.

Writing is a comparatively easy subject to teach if taken in the right way; and it is a subject not only of great interest to the children, but also of gratification to the teacher, who is enabled to see the actual result of his teaching.

If the letters are analysed, they may be resolved into some three or four simple elements, none of which present much difficulty, and good writing consists of the proper formation and combination of these. The points to be aimed at are—legibility, uniformity of slope, size and distance, and beauty of form. None of these by itself is enough; they must be combined.

The chief causes of bad writing are very obvious to the thoughtful student. The greatest, perhaps, is the wrong manner of holding the pen. When children commence letter-forming on slates with pencils, little care is bestowed upon this point, with the result that a bad habit is formed, which becomes particularly noticeable when the child commences to write with a pen. It is practically impossible to write well if the hand is not in a proper position. Certainly with a large expenditure of effort a copy can be made which looks fairly good; but all teachers must notice that when a child begins to attempt any speed the quality of the writing suffers. It should *not*. With proper position and a pen rightly held, a good rate may be attained, and the shape of the curves is rather improved than otherwise. Another cause of inferior writing is the fact that children are allowed to go on practising an incorrect stroke with little correction. All classes need occasional lessons on the "pot hooks and hangers" of the infant school from models supplied by the teacher on the blackboard. Printed headlines are very useful if the teacher cannot set a copy; but where he *can* (and this should be the case everywhere), it is much better to use exercise books, and set all copies on the blackboard. A child naturally takes more interest in attempting to do what he has seen some one actually do than in copying a line of print.

The questions given in the text-book cover the whole range of the subject.

4. *Drawing.*—One or two copies should be done each week, and I strongly advise students to drop the pen and pencil in lining in and use a brush with sepia. It is extremely difficult to obtain a smooth curve with a hard pen; the brush is far easier.

5. *Music.*—Common musical terms. The text-book will supply these. Note carefully that the terms may be divided into three sections, those referring to *pace*, *style*, *volume of sound*. It is very common to find *rallentando* defined as "slower and softer." This is not so.

The following terms are often unknown. *Calando* = decreasing in force; *con brio* = with vigour; *con tenerezza* = with tenderness; *maestoso* = with grandeur; *segue* = it follows; *sempre* = always; *più* = more; *poco* = a little.

6. *Penmanship.*—Ten minutes' practice daily from the *Practical Teacher Copy Book*, and great care at all times. Some of the specimens sent in to me are lamentably bad, chiefly because the pen is held in such a position that it is impossible to acquire fluency and good shape.

7. *Composition.*—Write one or two essays per week on such subjects as—

(*a*) The probable future of South Africa.
(*b*) Canada as a field for emigration.
(*c*) The effects of the Wars of the Roses.
(*d*) Contentment is better than riches.
(*e*) The value of pictures in a school.
(*f*) Our national food supply.
(*g*) Gardens.
(*h*) Why is Shakespeare considered a great dramatist?

Read up the subject where necessary, and digest your facts into a note-book to be committed to memory, taking care to arrange the ideas in proper order under suitable heads.

The following notes on this month's subject may be of use:—

(*a*) You might deal first with the government. The Transvaal and the Orange River Colony will soon receive home rule or autonomous government, Rhodesia will be taken over by the Government as soon as it fills up sufficiently, and then Cape Colony, Natal, and the others will probably be federated. With regard to the industrial future, South Africa will never be an agricultural country. It will be for a long time dependent on its mines for its prosperity. Another problem will be the question of the natives, who will outnumber the whites for a long time.

(*b*) First point out the natural advantages—abundant mineral and animal wealth, a rich soil, abundance of timber, fine climate, navigable rivers. Its future will be agricultural at first, then mining and manufacture. The only things needed are hard-working men and capital. Point out the kind of man required, and how he may succeed. The handbooks of the Dominion Government will supply all that is necessary.

(*c*) The historical text-book will supply the facts necessary. The main point is the total collapse of the feudal system and everything connected with it.

(*e*) Very little thought will show the great importance of pictures in such lessons as geography and history. In object lessons they are invaluable. Point out that they teach by the *eye* where the teacher has to depend on the ear and the imagination.

(*f*) This is a much debated subject. Probably England could supply itself with the necessaries of life, but all luxuries in the way of food come from tropical or sub-tropical countries. See *Whitaker* on the imports and exports.

(*g*) This may be dealt with in a variety of ways—for example, the utility of a garden for supplying needs, as a means of recreation, etc. The "earth hunger" of the Anglo-Saxon race is responsible for the desire of every one to possess some piece of ground which is his to the exclusion of all others. The mental delight of watching the growth and development is not to be overlooked.

(*h*) (1.) His versatility—he writes on every topic.
(2.) His command of language—he uses more words than any other writer.
(3.) His infinitive knowledge of human nature in all its phases.
(4.) His power of characterisation. No two of his characters are alike.

8. *English.*—(1.) Learn twenty-five roots and meanings each week.

(2.) Prepare thoroughly the grammar and syntax of the Preposition and Conjunction.

(3.) The *Task*, Book V., lines 193-220.

(4.) *As You Like It*, Act III., Scene i. and Scene ii. to line 221 (Enter Orlando and Jaques).

(5.) The writers of the time of Queen Anne—Defoe, Swift, Addison, Steele, etc.

Notes on English.

The Conjunction.—A careful classification must be learned. Conjunctions may be classified in two ways. (*a*) According to the rank of what they join—co-ordinate, joining words or sentences of equal rank; and subordinate, joining subordinate to principal sentences. (*b*) According to meaning: for example—

Simple	= and.
Adversative	= but, yet.
Alternative	= either...or, neither...nor, whether...or.
Temporal	= after, before, till, while, since.
Causal	= because, since, for, lest, that.
Hypothetical	= if, unless, except.
Concessive	= though, although, albeit.
Comparative	= than.

Do not use the objective after *than* and *as*—for example, "He is taller than me," "I can run as fast as him." In each case the conjunction joins on an elliptical sentence. "He is taller *than* I am tall," etc.

"As You Like It."

Act III., Scene i.—Oliver has come before the duke in obedience to the commands given in Act II., Scene ii.—"If he be absent, bring his brother to me"—and denies all knowledge of his brother's whereabouts.

Were I not, etc. If I were not more merciful than just, I should not seek thy absent brother, but take my revenge on thee, who art present.

Seek him with candle, look diligently. Probably a reference to Luke xv. 8: "The woman doth light a candle, and sweep the house, and search diligently till she find it."

Of what we think. Of is a preposition governing a noun sentence.

Make an extent upon = make a seizure of.

Scene ii.—*Thrice-crownèd* = queen in three places—Cynthia in heaven, Diana on earth, and Proserpina in hell.

Unexpressive = inexpressible.

She = woman. Compare, "Where'er she be,
The not impossible she."

Hast any philosophy in thee? Touchstone is purposely bewildering the rustic by his speech.

Thou never sawest good manners. The reasoning is wrong, because the clown changes the meaning of the word. At first he takes "manners" to mean polite behaviour, the outward courtesies of good society; in the next sentence he uses it as *morals*.

Parlous = perilous—a mispronunciation of the word.

More sounder. A double comparative.

Civet, a perfume obtained from the civet cat, a carnivorous animal of the tropics.

Perpend, consider. A word used bombastically.

God make incision in thee, may God cure thee. An incision is a cut; and bleeding was the commonest surgical remedy for all diseases in those times.

Raw, inexperienced, unpolished.

Right butter woman's rank to market. The word "rack" has been suggested for "rank." The *rack* is an easy pace of a horse, and Touchstone means that the verses run easily as a horse "racking." But the passage is intelligible as it stands. All the words rhyme with "Ind," and Touchstone then means they follow each other with the same monotony as a string of women riding to market. This meaning is borne out by the fact that he goes on rhyming to the same word.

Graff, graft, an arboricultural operation, by which a branch of one tree is made to grow on another.

Medlar, a play on the words *meddler* and *medlar*. The latter is a fruit, in shape like a small pear.

Quintessence of every sprite, the best and purest part of every spirit. "Quintessence" is an old term, meaning literally the essence prepared by repeated distillations.

Pythagoras, a Greek philosopher of the sixth century, who taught the transmigration of souls—that is, that the soul of a man may pass into the body of an animal.

Irish rat. The superstition about Irish rats being rhymed to death was a stock Elizabethan joke.

One inch of delay more is a South Sea of discovery. There are various explanations of this—"Another moment's delay, and you will be encountered with innumerable questions as boundless as the South Sea;" or, "If you delay another moment, I will set forth on a journey to find him."

Gargantua's mouth. Gargantua was a giant in a work by the great French writer Rabelais. He is credited with swallowing five pilgrims with their staves in a salad.

Kill my heart, a quibble on *hart*, a stag.

Without a burden, with a continual accompaniment or flow of exclamations.

9. *Geography.*—(*a*) The Dominion of Canada.
(*b*) Finish the revision of Asia.

The Dominion of Canada is a part of the empire which is now deservedly receiving a large share of attention from Britain. The idea that it is a snow-covered country—"a few acres of snow," as the French king called it—is being dissipated, and emigrants are becoming aware in ever increasing numbers that Canada offers them greater prospects than any other colony. The enormous mineral wealth, the soil, whose fertility is inexhaustible, the glorious climate, the splendid waterways, make it capable of supporting a population of fifty millions instead of five. It offers much greater inducements to the hard-working, determined man than Australia, or South Africa, or the United States.

Every student should read the excellent handbooks published by the Canadian Government, which may be had for the asking from the Agent-General for Canada, Victoria Street, London, S.W.

The following questions indicate the chief points:—

(1.) Name the chief physical features, industries, and exports of Manitoba and British Columbia.
(2.) With what objects should emigrants go to Canada? At what ports would they land, and to what parts would they go for different occupations?
(3.) Describe the river basin of the St. Lawrence.
(4.) Describe a journey across Canada by the C.P.R.
(5.) Write a short letter, as from a settler in North-West Canada, descriptive of his life and occupation in the summer months.
(6.) Name the provinces which form the Dominion of Canada, and give the principal towns and industries of each.
(7.) What effect have its mountain ranges upon the climate of British Columbia?
(8.) Describe the climate of Canada. Explain the names Montreal, Nova Scotia, Newfoundland, and Hudson Bay.
(9.) Say what you can of Anticosti, Halifax, Hudson Bay, Mackenzie, Ottawa, Vancouver City.
(10.) "The Dominion of Canada contains all kinds of climates, all sorts of productions, every variety of mineral wealth." Comment on this statement.
(11.) Say what you can of the lake system of British North America.
(12.) Describe as accurately as you can the situation and natural surroundings of the following towns: Vancouver City, Calgary, Regina, Winnipeg, Quebec, St. Johns (Newfoundland).
(13.) Give some account of the growth of the Dominion of Canada.
(14.) Describe exactly how Canada is governed.

The Dominion of Canada was formed in 1867 by the British North America Act, and Ontario, Quebec, Nova Scotia, and New Brunswick were united. In 1870 the Province of Manitoba was formed and admitted, together with the N.W. Territories. British Columbia followed in 1871; Prince Edward Island in 1873. Newfoundland alone has not joined. The Provinces have each a lieutenant-governor and a local legislature. The Territories—Assiniboia, Saskatchewan, Alberta, Athabasca (formed 1882), Ungava, Franklin, Yukon, and Mackenzie (1895)—are under one government; but probably the first four will soon be made into separate provinces. The central Government meets at Ottawa. It consists of—

(*a*) A Governor-General—the Earl of Minto.

(*b*) The Senate or Upper House, consisting of 81 members, appointed for life by the Crown.

(*c*) The House of Commons, consisting of 213 members, elected for not longer than five years.

The central Government decides what business shall be conducted by the provincial Parliaments. The advantages of federation are obvious. It enabled the Dominion to construct the Canadian Pacific Railway (which would have been an impossibility if each district had paid for its own section), by which the rich districts of Manitoba and Alberta have been opened, and British Columbia brought within easy access of the east coast.

Attention should be given to the inducements (free grants of land, etc.) offered by the Government.

10. *History.*—The Tudor Period (1485–1603).

With Henry the Seventh's reign we commence the study of what is known as modern history. The previous ages are known as the Dark Ages, from the ignorance and superstition which everywhere prevailed. The whole of Europe had for centuries been plunged in never-ending warfare, race against race, subjects against rulers; *might* had been largely *right*; no time had been given to knowledge or study except in the secluded cloisters of the monastery, and man had lived a life but little removed from that of the beasts around him. In a remarkably short time the clouds rolled away. A larger measure of peace prevailed, knowledge spread rapidly, the adventurous mariner, guided by the needle swinging on a card, boldly plunged into the unknown waste of waters, Columbus discovered America, Vasco de Gama doubled the Cape and opened a new road to the East, Cabot traced the course of the North American coast, Drake and others circumnavigated the world. Commerce rapidly extended,

new products found their way to our shores, and at the end of the period the first seeds of our gigantic empire were planted. The voice of the nation, rarely heard before, burst forth, and England became under Elizabeth a "nest of singing birds."

As in history no revolution of this kind takes place spontaneously and without long preparation, the student must weigh carefully the causes which produced this revival of learning, or Renaissance.

(1.) The feudal system was done with. Relieved from the continual business of fighting, men turned their thoughts to more useful subjects.

(2.) The invention of printing allowed of the rapid and cheap multiplication of books.

(3.) The great religious dispute which convulsed the whole of Western Europe drove men to study.

(4.) The capture of Constantinople by the Turks in 1453 scattered the learned men who had congregated there. They fled to all parts of Europe with their precious parchments, and each became a centre for the dissemination of learning.

Henry the Seventh.—Chief points.

(1.) Causes of the great arbitrary power exercised by the Tudors.

(*a*) The Wars of the Roses had destroyed the great barons, and their recovery was prevented by the Statute of Livery and Maintenance.

(*b*) The Commons were not yet strong enough to oppose the king.

(*c*) The church, alarmed at the Reformation, relied on the kings for support, and was therefore subservient.

(*d*) The Tudors were monarchs of great personal character—able, tactful, and popular.

(*e*) Henry the Seventh held the only artillery in the kingdom, against which it was hopeless for armoured knights to fight.

(2.) Plots against the king—overcome with ease. Each resulted in the king's acquisition of treasure and lands.

(3.) Henry's means of obtaining money.

(*a*) Confiscation of Yorkist estates.

(*b*) Forced loans and benevolences—Morton's Fork.

(*c*) By Empson and Dudley—inflicting fines for breaking obsolete laws.

(*d*) Subsidies for war with France, and payment from the French *not* to fight.

(*e*) By the Star Chamber.

(4.) Marriage Schemes.—(*a*) Catherine of Aragon with Prince Arthur. Large dowry—one cause of the Reformation in England. (*b*) Princess Margaret with James the Fourth of Scotland—resulted in the Stuarts coming to the throne.

(5.) Star Chamber.—A committee of the Privy Council to try offenders whom no jury dared convict—abolished in 1641. Had the power to inflict any punishment short of death.

Henry the Eighth.—(*a*) Wolsey's administration; Field of the Cloth of Gold; Battle of Flodden, etc. (*b*) The Reformation.

(1.) Causes.

The corruption of the church—laziness and immorality of the monks.

The Papal schism—when there were two Popes, each claiming to be the only one, and excommunicating the other.

The teaching of the Lollards and Wycliffites.

The revival of learning, which led men to go to the Bible for information.

The sale of indulgences.

(2.) Course in England.

Henry was *not* a reformer. Separated from the Church of Rome in order to get a divorce; burned Catholics and Protestants alike—former for denying his supremacy, latter for unorthodox belief.

Dissolution of monasteries, and its effects. Pilgrimage of Grace.

Statute of Six Articles.

(3.) Points on which the reformers differed from the church.

Transubstantiation, celibacy of clergy, vows of chastity, communion in one kind, auricular confession, prayers for the dead.

Edward the Sixth.—Progress of the Reformation.

Condition of the poor, who were deprived of their only friends by the dissolution of the monasteries, and thrown out of work by the farms being turned into sheep runs. Ket's rebellion.

Mary.—Wyatt's rebellion.

The Marian persecution.

The Spanish marriage and the war with France.

Elizabeth.—A reign of the greatest importance, during which England made great advance in every respect.

On accession Elizabeth had the following difficulties to meet: no army, no navy, an empty treasury, a religious hatred between the two parties, little trade or commerce, hostility of France, Spain, and the Pope. The way in which each difficulty was overcome must be carefully studied.

Mary Queen of Scots; Spanish Armada; rebellion in Ireland; the "sea dogs" and their doings; the great writers.

11. *Arithmetic.*—Percentages, and profit and loss. Chaps. xxvi. to xxix., Christian and Collar, and work 251–300 General Examples, sending up for solution any sum presenting difficulty.

12. *Algebra.*—Quadratic equations, chap. xxv., Hall and Knight.

Solve these by using the formula $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$.

Be prepared to establish this from the general form of the equation $ax^2 + bx + c = 0$.

The proof that quadratics cannot have more than two roots must be learned.

13. *Euclid.*—Book II., Props. 1–4, with six deductions per week.

14. *Science.*—Elementary properties of carbon, iron, mercury, water, carbon dioxide, lime, silica.

15. *General Information.*—Work one or two papers each week from one of the books of questions published.

Notes on April Paper.

Question 1 usually well done.

2. The six Great Powers are England, France, Germany, Austria, Russia, and Italy. Several students omitted to notice that each army has a *peace footing* and a *war strength*.

	Peace Footing.	War Strength.
England	284,000	934,000
Austria	361,693	1¾ to 4 millions.
France	600,000	3 millions.
Germany	585,000	4 ,,
Italy	261,000	2¼ ,,
Russia	860,000	3½ ,,

3. Most answers about the coat were wrong. A *white* coat is warmer. There is no heat from outside to absorb, hence the aim is to prevent radiation from the body, and *white* is the best non-conductor.

The other answers were well done.

Test Paper on General Information.

The answers to these questions are marked gratis. They should be written on foolscap, on one side only; the coupon of the present number and a stamped addressed envelope should be enclosed. All papers must be sent direct to Mr. A. T. Flux, Oakleigh, Belvedere, Kent. A prize of one guinea will be given to the student securing the highest percentage of marks.

1. How is a newspaper printed?

2. Explain the following extract from a weather report:—"The readings of the barometer range from above 30 inches over Portugal to below 29.4 inches in a shallow disturbance which is in course of dispersal over England, to a rather lower figure to the westward of Ireland. Gradients are moderate or slight." What sort of weather would this indicate in England?

3. What are import duties? What are the duties on coffee, tea, tobacco, brandy, and milk?

4. What is meant by the "rule of the road"?

5. Give the composition of our gold, silver, and bronze coinage. For what amounts are Bank of England notes issued? What is the greatest amount you can legally pay (*a*) in silver, (*b*) in bronze?

6. Who is the author of *Children of Gibeon, The Light that Failed, The Light of Asia, The Last Days of Pompeii, The Decline and Fall of the Roman Empire, Heroes and Hero Worship, The Advancement of Learning?* Give a very brief synopsis of one of them.

7. What is the meaning of the following names:—Costa Rica, Philadelphia, Gloucester, Laccadive, Allahabad, Cartagena, Naples, The Minch?

8. Where and what are the following:—Cleopatra's Needle, the Eiffel Tower, Fifth Avenue, Unter den Linden, the Corso, the Kremlin, Arthur's Seat, the White House?

Test Questions on Last Month's Work.

1. *Penmanship.*

Large Hand.—*Tranquillity.*

Small Hand.—*Higher yet and higher, from the earth thou springest.*

2. Give an outline of a lesson in word building to Standard V. on the Latin root *specio, spectum,* I look.

3. Write an essay on "The Revival of Learning."

4. Analyse the following, and parse words in italics :—

"When I *did* hear
The motley fool thus moral on the time,
My lungs began *to crow like* chanticleer
That fools *should be so* deep-contemplative,
And I did laugh *sans* intermission
An *hour* by his dial."

5. Work out a classification of the adverb.

6. Say what you can of Natal. Give a sketch map.

7. Give some account of the progress made by Japan during the last twenty years.

8. Explain clearly the causes of the English non-success in France in the latter part of Henry the Sixth.

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10. Work the following :—

(1.) A sum of £10000 is to be divided between several claimants, so that some are to receive £80, 12s. 10d., and the others £80, 12s. 11d. How many persons will receive each of these amounts?

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(3.) Give the rule for reducing to a vulgar fraction a decimal fraction which contains a recurring period, and prove the rule in the case of $\cdot 03\dot{1}\dot{6}$.

$$\text{Simplify } \frac{\cdot 6\dot{8} \times \cdot 6\dot{0}\dot{8}}{\cdot 0\dot{6}\dot{8} \times \cdot 0\dot{6}\dot{0}\dot{8}}.$$

(4.) A train approaching a station at the rate of 25 miles an hour passes over two fog signals placed half a mile apart. Find the interval between the times at which their reports are heard at the station, sound travelling at the rate of 1,100 feet per second.

11. Explain clearly the difference between a mechanical mixture and a chemical compound.

12. How would you prepare hydrogen, and what experiments would you work to show its properties to a class?

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A number is divisible by 9 if the sum of the digits is divisible by 9.

A number is divisible by 10 if the number ends in 0.

A number is divisible by 11 if the sum of the digits in the even places equals the sum of the digits in the odd places, or if the difference is divisible by 11.

A number is divisible by 12 if divisible by 3 and 4, etc.

To prove that the answer, when you have obtained it, *is* the G.C.M., divide each number by the G.C.M., and show that the quotients have not a common factor. There is a splendid set of exercises given in the text-book.

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7. *Music.*—Pitch, and the standard scale of pitch.

Questions on Last Month's Work.

(1.) Analyse :—

Beneath *those* rugged elms, that yew tree's shade,
Where heaves the turf in *many* a mouldering heap,
Each in his narrow cell *for ever laid*,
The rude forefathers of the hamlet sleep.

(2.) Write an essay on "Spring."

(3.) (*a*) If a number is divided by the factors 7, 8, 9, and the remainders are 5, 3, 7, what is the total remainder? What would the remainders have been if the number had been divided by 8, 7, 9? Ans. 418; 2, 3, 7.

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(6.) What did Alfred do that he should be called "Great"?

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(8.) Describe experiments to prove that matter is indestructible.

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1. *Reading and Repetition.*—See note above.

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Paraphrase and analyse the whole. Parse all words presenting difficulty.

3. *History.*—Henry the First, Stephen, Henry the Second, and Richard.

Chief points.—Henry the First's right to the throne. Contest with Robert. Henry's charter.

Was Stephen a usurper? The Civil War. Why did the Scots help Matilda? The wretched condition of the poor.

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(1.) Extent of his dominions; how he acquired them.

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(4.) Rebellions of his sons.

Richard—(1.) Government at home in the king's absence.

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4. *Geography.*—Belgium, Holland, Denmark, Norway and Sweden, Switzerland.

Follow the same method as indicated before. Prepare maps, mark all places to be remembered, and commit to memory.

Pay especial attention to industries, imports, exports, and towns.

Students are invited to write for any explanation and assistance they need. It is impossible to deal with all points which would arise, in these columns.

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8. *Mathematics.*—Euclid: Definitions, axioms, postulates, and Props. 1–4.

Algebra: Substitution of numerical values and brackets.

Test Questions.

1. Analyse and paraphrase—

"He from the stack.....
.....own unbalanced weight."

or, "All speak her happy.....
.....move to tears."

2. Parse *again deep plunging oft, smooth, wall, such, care, lest, weight;* or, *happy, let, only what, unregarded, wherefore.*

3. In what respects did the Feudal System in England differ from that on the Continent?

4. What do you know of the Investiture Dispute?

5. Say what you can of the industries of France, and mention the chief towns engaged in them.

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Ans. 13·7; 2·07.

(*d*) A railway rises 1 foot in 80 for ¼ mile, 1 in 120 for 1,500 yards, and 1 in 110 for ½ mile; find the average rise.

Ans. 1 foot in $108\frac{6}{11}$.

8. Describe exactly how a mercurial thermometer is constructed and graduated.

Second Year.

1. *Reading and Repetition.*—Remember that oral practice, with due attention to emphasis and modulation, is imperatively necessary with these subjects.

2. *Geography.*—British possessions in Africa. (For notes, see the last two numbers, under "Scholarship Course.")

The following questions have been asked:—

(1.) What do you know of the climate and productions of British South Africa?

(2.) State as accurately as you can the boundaries of Cape Colony; and compare the colony (*a*) in size, (*b*) in climate, and (*c*) in population with Great Britain.

(3.) How is Cape Colony governed? Is it well suited for agriculture? What minerals are found in the colony?

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(5.) A great hindrance to progress in Africa is the difficulty of enlarging production. Show, as carefully as you can, how this difficulty is being removed.

[This question is not very clear. What is probably meant is what is being done to facilitate export and import—namely, Cape-to-Cairo Railway, railway from Salisbury to Beira, improved methods of agriculture, etc.]

(6.) Account, as fully as you can, for the fertility and present importance of Egypt; and describe the position of Cairo, Port Said, Alexandria, Khartoum.

(7.) Give some account of the races, climate, and productions of British East Africa.

(8.) Describe briefly the course of the Cape-to-Cairo Railway; say what you can of the portion already completed, and the probable effects of such a railway.

(9.) Enumerate and describe the West African possessions of Great Britain.

(10.) A line of steamers runs regularly from Liverpool to the West Coast of Africa. Mention the chief ports of call, and the principal articles which form the cargo on the outward and homeward voyages respectively.

3. *History.*—Charles the Second, and James the Second.

Charles the Second possessed all the Stuart ideas as to Divine Right, but he was far too clever to endeavour to enforce these upon the people himself. He professed to place himself in the hands of his ministers, and allowed the anger of the nation to fall on them for doing what he had himself compelled them to do. Thus Clarendon was sacrificed to appease the national anger at the disgraceful conduct of the Dutch War, the Cabal Ministry for the misrule and attempts to suspend laws against the Nonconformists and Catholics, Danby for having signed the Secret Treaty of Dover. "No man ever trusted a Stuart but it was to his own ruin." The chief points are:—

(1.) Clarendon's Ministry, 1660–1667—
The Convention Parliament; the Cavalier Parliament.
Clarendon Code—Corporation Act, Act of Uniformity, Conventicle Act, Five-Mile Act.
The First Dutch War: caused by trade rivalry, ending in the Treaty of Breda.
The Great Plague and the Great Fire.

(2.) Cabal Ministry, 1667–1673—
Triple Alliance and Secret Treaty of Dover.
Second Dutch War.
Test Act.

(3.) Danby's Ministry, 1673–1679—
Conclusion of Dutch War.
Six secret treaties with France.
Popish Plot invented by Titus Oates.

(4.) Habeas Corpus Parliament, 1679—
Habeas Corpus Act.
Exclusion Bill, to prevent James, a professed Catholic, from ascending the throne.
The Rye House Plot.

(5.) James the Second—
Rebellions of Argyll and Monmouth.
Declarations of Indulgence; trial of the Seven Bishops.
Landing of William of Orange.

4. *English.*—Milton's *Paradise Lost*, Book III., lines 102–197. (Messrs. T. Nelson and Sons' Edition.)

It will be of great assistance to students to write the poem out in prose order, filling in the elliptical sentences; in fact, this is nearly imperative, to understand the analysis of some passages. Special attention should be given to Milton's views on Predestination, the gloomy doctrine of the Calvinists. They argued thus: God is omniscient, therefore He knows everything that is going to happen; and every man's life is known, and therefore each man's career is specially marked down for him, and he cannot escape it. Milton shows that this conclusion is wrong. The fact that God knows what is going to take place is not a cause of its occurrence, any more than a person who happens to know that a bridge is broken down when an express train is approaching can be charged with causing an accident. "Foreknowledge had no influence on their fate." Each man has a free will to choose right or wrong; and because it is known which he will choose, he cannot be said to be compelled to that particular choice.

The doctrine of the Atonement is also important.

5. *Arithmetic.*—Profit and loss. Look through all the exercises in Christian and Collar, and be sure you can work all. Send up any difficulties for solution.

6. *Music.*—Musical terms.

7. *Elementary Science.*—Preparation and properties of oxygen, hydrogen, and nitrogen.

4. Analyse the following, and parse words in italics :—

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My lungs began *to crow like* chanticleer
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The First Dutch War: caused by trade rivalry, ending in the Treaty of Breda.
The Great Plague and the Great Fire.

(2.) Cabal Ministry, 1667–1673—
Triple Alliance and Secret Treaty of Dover.
Second Dutch War.
Test Act.

(3.) Danby's Ministry, 1673–1679—
Conclusion of Dutch War.
Six secret treaties with France.
Popish Plot invented by Titus Oates.

(4.) Habeas Corpus Parliament, 1679—
Habeas Corpus Act.
Exclusion Bill, to prevent James, a professed Catholic, from ascending the throne.
The Rye House Plot.

(5.) James the Second—
Rebellions of Argyll and Monmouth.
Declarations of Indulgence; trial of the Seven Bishops.
Landing of William of Orange.

4. *English.*—Milton's *Paradise Lost*, Book III., lines 102–197. (Messrs. T. Nelson and Sons' Edition.)

It will be of great assistance to students to write the poem out in prose order, filling in the elliptical sentences; in fact, this is nearly imperative, to understand the analysis of some passages. Special attention should be given to Milton's views on Predestination, the gloomy doctrine of the Calvinists. They argued thus: God is omniscient, therefore He knows everything that is going to happen; and every man's life is known, and therefore each man's career is specially marked down for him, and he cannot escape it. Milton shows that this conclusion is wrong. The fact that God knows what is going to take place is not a cause of its occurrence, any more than a person who happens to know that a bridge is broken down when an express train is approaching can be charged with causing an accident. "Foreknowledge had no influence on their fate." Each man has a free will to choose right or wrong; and because it is known which he will choose, he cannot be said to be compelled to that particular choice.

The doctrine of the Atonement is also important.

5. *Arithmetic.*—Profit and loss. Look through all the exercises in Christian and Collar, and be sure you can work all. Send up any difficulties for solution.

6. *Music.*—Musical terms.

7. *Elementary Science.*—Preparation and properties of oxygen, hydrogen, and nitrogen.

THACKERAY AND "ESMOND."

William Makepeace Thackeray was born in Calcutta in 1811, his father occupying a position in the East India Company Civil Service. About 1816, after his father's death, his mother, with her only son, returned to England. The ship called at St. Helena, and here "my black servant," says Thackeray, "took me a walk over rocks and hills till we passed a garden where we saw a man walking. 'That is Bonaparte,' said the black; 'he eats three sheep every day and all the children he lays hands on.'"

Thackeray went to the famous Charterhouse School, and early showed his literary bias by the production of witty and satirical poems. When he was eighteen he entered Trinity College, Cambridge, and there contributed short articles to *The Snob* and *The Gownsman*. After a year he left college without a degree, and went to Weimar and Paris to study art. Although these studies did not make him an artist, they taught him how to make those exquisitely humorous pen-and ink sketches with which he illustrated some of his pieces.

In 1832, at the age of twenty-one, he came into a fortune of £500 a year: but this was soon dissipated, partly by a bank failure, but mainly in the alluring project, which has ruined many a man, of running a paper. He at once set to work, attempting at first to find employment as an artist. In pursuit of this he first met Dickens. "I recollect walking up to his chambers in Furnivall's Inn with two or three drawings, which, strange to say, he did not find suitable!" But it was in "word painting" that he found his true bent. He began contributing to *Fraser's Magazine* under the signature of "Michael Angelo Titmarsh." Some of his papers were *The History of Samuel Titmarsh* and *The Great Hoggarty Diamond*, and papers on Paris.

In 1837 he married, but after a few years his wife's mind failed, and the home was broken up.

About 1840 he began writing for *Punch*, and continued his connection with that paper till 1853, when he withdrew owing to the attacks made on the Emperor of the French by the paper. This work brought him into the fellowship of such men as Douglas Jerrold, Gilbert à Becket, and John Leech. The best known of his contributions to this paper are *The Snob Papers*, *Jeames's Diary*, and *The Ballads of Policeman X*. In the *Snob Papers* Thackeray attacked with caustic wit the cant and hypocrisy of his age. His biting sarcasms found him many friends—and enemies. In his desire to expose the follies and affectation of the people, which Addison had many years before treated with banter and good-humoured mockery, and which Carlyle thundered at with furious ire, he sometimes went beyond the legitimate scope of his subject and attacked manners and men which he might well have spared, and brought upon himself the retort that he was the greatest snob of any.

Jeames's Diary, written in a wonderful phonetic English, exposes the hollowness and insincerity of the fashionable society of the time. The flunkey, James De La Pluche, by lucky investments in railway shares, becomes rich, and imitating the manners of those with whom he had lived, presents a grotesque picture, which is familiar to most readers.

His first novel, *Vanity Fair*, commenced in 1846, and issued in monthly instalments, attracted great attention from the first number, which steadily grew with each succeeding part. Its *motif* is, as in other writings, the shams of society. Trollope says that his purpose was that "as the central character of Dickens had always been made beautiful with unnatural virtue, so should his centre of interest be in every respect abnormally bad." In this he certainly succeeded. Becky Sharp, the unprincipled adventuress, is far more interesting than the virtuous, amiable, and colourless Amelia Sedley.

In 1848 he commenced *The History of Arthur Pendennis*, also in monthly parts. Three years later, when his name had become well known and his writings popular, he did as was common in those times—commenced a series of lectures. He chose for his subject *The English Humorists of the Eighteenth Century*, and gave a series of witty and clever lectures on Pope, Addison, Swift, Steele, Goldsmith, and other writers, in Willis's Rooms. The venture was a great financial success. One result of the study which he had made of this period was the writing of a novel based on the life of that period, and in 1853 *Esmond* was published.

This is the most highly-finished and the best of his novels. It was the first to be issued as a whole and written on a definite plan. When an author commences a story in monthly parts his main object is to make each section attractive, and to lead up to some scene or difficulty which will ensure the reader buying the following number. The general effect of the whole is thus often spoiled, as if a painter should endeavour to make each square foot of canvas bear a complete picture instead of devoting himself to the production of a harmonious whole.

The special study which Thackeray had made of the writers of this period enabled him to couch the story in the language of the time of which it deals. Though not professedly a historical novel, it presents a very perfect picture of the life, thought, manners, and politics of the Augustan age of English literature. Readers of Scott understand how he frequently sacrifices historical facts or rearranges them to suit his purpose, thus confusing what is historically accurate with what is not. This Thackeray does not do. Beyond one or two slips in the dates, historical accuracy is carefully preserved.

The story is most interesting, because the characters are real men and women—real in the sense that they are neither superlatively good nor impossibly bad, but compounded, as all men and women are and ever will be, of both good and bad combined in varying proportions. In this they differ from those of Dickens, whose heroes and heroines are nearly faultless, and whose villains have scarcely a redeeming feature.

Esmond himself is a good-natured, magnanimous gentleman. Brought up in a subservient position, he is as a boy painfully aware of it, and naturally becomes reserved—a thinker and student. When brought for the first time into the society of a woman who treats him in a very friendly, one might say motherly, fashion, his young heart naturally goes out in adoration. Unjustly accused, and aware of his real birth, he prefers to bear the stigma of illegitimacy to inflicting pain on the woman for whom he possesses a deep affection. It was quite natural that he should fall in love with Beatrix, and equally so that she would have none of him. It was fortunate for him that she would not, for their married life would have been a veritable misery. Beatrix understands his character thoroughly. "You would have been weary of the goddess when she was called Mrs. Esmond, and got out of humour because she had not money enough. I should have been sulky and scolded.....You want a woman to bring your slippers and cup, and sit at your feet and cry, 'O curo! O bravo!' whilst you read your Shakespeares, and Miltons, and stuff."

That Esmond should have dangled after the beauty is weak, especially when she had been so cruelly candid, and when he should have known that to marry her would have ensured their continual misery. In the end he marries the mother, and it requires all the author's skill and tact to make this agreeable to his readers; in fact it can hardly be said that he has done so. A boy's love for a woman is natural; that of a man for a woman ten years his senior not so, especially when he has been making love to the best of his ability to her daughter. However, Esmond probably found much truer happiness with the mother than he ever could have done with the daughter.

The other characters want little interpreting; they are apparent to every reader.

Viscount Castlewood is a good-natured, jovial person, fond of drinking and good company, and not at all the divinity which his wife tries to make him. She sets him on a pedestal, which is an uncomfortable position for him, and worships him till he is thoroughly sick of it. Perfectly aware of the fact that he is not, and never can be, the hero she designs him for, he gladly slips away from a lonely position to take his fun with those who take him for what he is. Had she been a little more tolerant, and, may we say it, a little less "unco guid," they might have passed their lives happily together and never drifted apart. The catastrophe is as much the woman's fault as the man's: a little incense may sometimes be pleasant, too much of it is suffocating.

It is to be hoped, for Esmond's sake, that his lady learned by the experiences of her first marriage; in fact, as the story proceeds, her character seems to develop and become wider, more tolerant, and more womanly.

In Beatrix we have a finished picture of the designing young woman of the period. From her cradle her mind is set on receiving homage as a matter of course, and on doing well for herself. There is nothing in her to admire, and when her vaulting ambition o'erleaps itself, it does not evoke our pity. She is an example of the beautiful woman, common in all ages, on whom nature has lavished all her gifts externally, and entirely forgotten to place a heart inside.

The language of the story is easy and natural. It was probably written by Thackeray with pleasure—an enjoyment rather than a task. Many of the scenes are intensely dramatic, and exhibit the greatest power. The interview after Esmond's return to Winchester is one of the finest incidents in the whole range of fiction. "'I knew you would come back—I own that. And to-day, Henry, in the anthem, when they sang it, "When the Lord turned the captivity of Zion, we were like them that dream," I thought, yes, like them that dream—them that

dream. And then it went, "They that sow in tears shall reap in joy; and he that goeth forth and weepeth, shall doubtless come home again with rejoicing, bringing his sheaves with him." I looked up from the book, and saw you. I was not surprised when I saw you. I knew you would come, my dear, and saw the gold sunshine around your head.'"

LOGIC FOR L.L.A. AND LONDON MATRICULATION.

BY T. E. MARGERISON, M.A. (LOND.),

Principal of the Tottenham Pupil Teachers' Centre.

XI.

Fallacies.—A fallacy is an inference which, while it is apparently valid, violates some logical principle. After establishing rules for correct reasoning, Logic proceeds in the doctrine of Fallacy to consider arguments which will not bear the test of those rules, to show in what respects they are defective, and to classify the commonest forms of error. This part of Logic is therefore essentially practical; it assists us not only readily to detect fallacious reasoning, but also to ascertain exactly wherein the weakness of the argument lies, so that we can the better refute it.

Classification of Fallacies.—Aristotle divided fallacies into two classes:—

1. *Fallacies in dictione*, or those which lie in the *form* of the statement.
2. *Fallacies extra dictionem*, which arise outside of mere verbal statement.

Each of these groups was divided into sub-classes. The classifications now most commonly used are founded on that of Whately, by which we get the following divisions:—

1. *Purely logical Fallacies*, including breaches of the syllogistic rules, such as Fallacy of Four Terms, Undistributed Middle, and Illicit Process (Major or Minor).
2. *Semi-logical Fallacies*, which require some knowledge besides that of logical rules in order that they may be detected. They correspond with Aristotle's fallacies *in dictione*, and include Equivocation, Amphibology, Composition, Division, Accent.
3. *Non-logical or Material Fallacies*, corresponding to Aristotle's second group. Aristotle enumerates seven kinds—namely, Accident, Converse of Accident, Irrelevant Conclusion, Consequent, Petitio Principii, False Cause, and Many Questions.

The purely logical fallacies, resulting from the breaches of the rules of the syllogism, have been already discussed; it will not be necessary, therefore, to deal with them again here.

Semi-logical Fallacies.—In each of these the fallacy results from the employment of a term or proposition, so as to admit of more than one interpretation.

In **Equivocation** a *term* is used in a double sense, thus—

A church is a building.
A body of believers is a church.
∴ A body of believers is a building.

Amphibology occurs when a proposition is so loosely constructed that it is possible to give it more than one meaning, as in,

"I perceived it had been scoured with half an eye."

The fallacy of **Composition** lies in asserting that what is true of all the members of a class individually is also true of the class as a whole. To say that because one man out of twenty can safely stand on a balcony therefore all the twenty can so stand is an example. The opposite fault of predicating of each individual that which is only true of the whole class together constitutes the fallacy of **Division.** All the angles of a triangle are together equal to two right angles, but no individual angle is equal to two right angles.

The fallacy of **Accent** consists in any ambiguity arising from misplaced emphasis. The simplest sentence can often be given several meanings by merely changing the emphasis from one word to another.

Material Fallacies—also known as fallacies *in re* or *extra dictionem*—require a knowledge of the matter about which the statement is made in order that they may be detected. It is not easy to give simple examples, as the error is then, as a rule, apparent; those most difficult to expose hide the fallacy in a multitude of words.

Accident is arguing from a general rule to a special case. A term is taken simply and unconditionally in one premise, while in the other it is limited in application by some condition or accident.

He who takes another's life is a murderer.
Soldiers take the lives of others.
∴ Soldiers are murderers.

The **Converse Fallacy of Accident,** on the other hand, argues from a special case to a general rule, as if we were to infer that food suitable for one invalid is therefore suitable for all.

Irrelevant Conclusion or **Ignoratio Elenchi** (ignorance of what is to be refuted) is the fallacy arising when a conclusion is proved which is not the point in issue. This false conclusion is so covered with words that its substitution is often disguised. It is a familiar resource of an orator with a weak case. A common example is the *argumentum ad hominem*, a process the essence of which is abandonment of the matter in dispute to attack the character of those engaged in it.

The **Fallacy of the Consequent** or **Non Sequitur** (it does not follow) is an argument where the conclusion does not depend upon and follow from the premises:—

Watering places are pleasure resorts.
Manufacturing towns are not pleasure resorts.
∴ The people of manufacturing towns are unhappy.

Petitio Principii, Begging the Question, or **Arguing in a Circle,** implies the assumption of the very fact that has to be proved, the fallacy being disguised by the use of different words to say the same thing, as in "Opium produces sleep because it is a soporific substance." This kind of argument takes us no further than our starting-point.

False Cause, Non Causa pro Causa, or **Post hoc, ergo propter hoc** (after this, therefore on account of this). This is a very common fallacy, causal connection being attributed without sufficient ground. A familiar instance is the old belief in the influence of the moon on the weather.

The fallacy of **Many Questions** is committed when two or more questions are combined and asked as one in such a way that no true answer can be given. A direct answer, "Yes" or "No," to a question of this kind results in the person questioned implying something more by his answer than he really means. A common instance is the question, "Have you left off beating your mother?"

QUESTIONS.

(Students can have their exercises corrected by sending them to the Editor, Logic Course, PRACTICAL TEACHER, and enclosing seven stamps.)

1. Examine the following arguments:—
   (*a*) The truly brave are never bullies; hence all bullies are cowards.
   (*b*) Wisdom is inseparable from benevolence; hence all benevolent persons are wise.
   (*c*) A man may smile and smile and be a villain; my friend Smith is always smiling, therefore he may be a villain.
   (*d*) This regiment behaves bravely in action, therefore it must be composed of brave men.
   (*e*) B condemns Napoleon and Cæsar. But Napoleon and Cæsar are great men. Therefore B condemns great men.
2. What Inductive Methods might be employed to ascertain—
   (*a*) The connection between education and crime.
   (*b*) The cause of a conflagration.
   (*c*) The effects of closing public houses on Sunday?
3. Examine the following arguments with a view to detecting and accounting for any material fallacies involved:—
   (*a*) If a body moves, it must either move in the place where it is or in the place where it is not. But a body cannot move in the place where it is, nor yet in the place where it is not. Hence a body cannot move at all.
   (*b*) The syllogism is useless, for it cannot lead us to any new truths.
4. Found arguments on the following analogies:—
   (*a*) What disease is to the body, vice is to the soul.
   (*b*) Words are to thought what money is to commodities.
   (*c*) The general is to the army what the mind is to the body.
   (*d*) A colony is to a mother country as a child is to a parent.
5. Examine the following arguments:—
   (*a*) If he turns red you may be sure he is guilty, for that is what the guilty always do.
   (*b*) Since the laws allow everything that is innocent, and avarice is allowed, it is innocent.
   (*c*) Timon being miserable is an evil-doer, as happiness springs from well-doing.

OUR CERTIFICATE COURSE FOR 1903.

BY GEORGE COLLAR, B.A., B.SC.,
Head-master of the Stockwell Pupil Teachers' School.

HAVING endeavoured to guide our readers through the syllabus, we will this month give a set of papers on the whole course, which should be answered as nearly as possible under examination conditions. Take each paper and answer it in the time given, without looking at text-books after you have seen the questions; it is better, in fact, not to look at the questions until you are about to answer them. In the actual examination, be sure that you fill in your name and the other particulars *before* you begin to answer the questions; there is a danger of omitting them if left to the end, and some superintendents of examinations refuse to allow even a name to be written after the moment for stopping. Read the instructions as to the number of questions you may answer and the methods you must adopt, and then carefully read all the questions before you begin to write. This is essential if you have a choice of questions, so that you may select those you can do best; but even when you are required to answer all the questions, it is advisable to read them all first, for frequently something is given in one question which may enable you to answer another, or may indicate the examiner's views. Unless you are told to answer the questions in the order in which they are set, it is a good plan to begin with the questions you can answer best, because the feeling of satisfaction arising from an answer done well is an incentive to write good answers to the rest; whereas an ineffectual struggle with a difficult question may so unnerve you that you will do badly in questions that are really easy and within your reach.

MUSIC.

(One hour.)

Candidates may answer the questions in either the staff or the tonic sol-fa notation, but *not in both*.

You are not permitted to answer more than TEN questions.

Staff Notation.

1. Write the following in the bass clef (adding the key signature), to sound two octaves lower:—

2. Write, in the bass clef, one octave of the scales of D flat and B major, placing the necessary sharps or flats before the notes, and *not* as a signature.

3. Arrange the sharps or flats of the following signatures in the customary order and position, and state for what major keys they stand:—

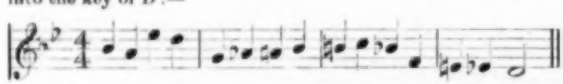
4. Write, in the treble clef, the following notes, each one to be followed by the note that is a major third above it:—G♯, A♭, B, and E♭.

5. Which notes of the major scale of E♭ bear minor thirds?

6. What is the difference between $\frac{2}{4}$ and $\frac{2}{2}$ time? Write four bars of each to illustrate your answer.

7. State the meaning of the following terms:—*Andante, allegro, sforzando, diminuendo, più mosso.*

8. Transpose the following passage a third higher—namely, into the key of D:—



9. Write an example of each of the following, together with its equivalent rest:—*Semiquaver, semibreve, crotchet, quaver,* and *minim.*

10. Write semibreves to show the relations named in the major keys indicated:—

11. Write a moderately difficult time exercise in $\frac{3}{4}$ time eight bars in length, suitable for children in the highest standards. No two bars should be exactly alike.

12. Transcribe the following into $\frac{4}{2}$ time, halving the value of each note and rest:—

Tonic Sol-fa Notation.

1. Which sounds or degrees of the following series are (*a*) a major 7th apart, and which (*b*) a perfect 5th apart?—

d r m f s l t d' r' m' f'.

2. What other degrees of the scale in *ascending* order are separated by the same succession of intervals as those forming the following groups?—

(*a*) **f l d' r'**, (*b*) **l d' m' f'**.

3. What are the mental effects of the following scale degrees when performed slowly in association with other degrees?—

(*a*) **lah**, (*b*) **fah**, (*c*) **soh**, (*d*) **ray.**

4. Name the following intervals:—

(*a*) **fe–de'**, (*b*) **r–le$_1$**, (*c*) **t$_1$–la**, (*d*) **la$_1$–fe**, (*e*) **m–ta**, (*f*) **se$_1$–f.**

5. Rewrite the following passages, making a change of key by bridge notes whenever you think it best. Return to the original key by bridge notes:—

(*a*) Key C.

m s f t$_1$ l fe s m fe d' t m l f m r d.

(*b*) Key C.

s d r f t$_1$ d s ta l f m r f ta l s l t d'.

6. Write (*a*) an augmented 4th above **doh**, and (*b*) a diminished 5th above **me**, and (*c*) a perfect 4th below **ta**, and (*d*) a major 6th above **lah.**

7. State which one of the following notes is highest and which one is lowest in pitch:—**fah** in Key B, **me$_1$** in Key B flat, **lah** in Key E, **doh'** in Key D, **te** in Key C, and **soh$_1$** in Key A.

8. Write the tonic sol-fa names that stand for the following major mode scale degrees:—(*a*) Tonic, (*b*) dominant, (*c*) mediant, (*d*) supertonic, (*e*) submediant, (*f*) subdominant.

9. Using "**d**" throughout, fill up two measures in each of the following kinds. Show at least one rest and one divided pulse in each measure:—(*a*) Six-pulse measure; (*b*) three-pulse measure; (*c*) four-pulse measure.

10. Write five four-pulse measures showing three examples of syncopation. Indicate which are the syncopated notes.

11. State the meaning of the following terms:—*Allegro, sforzando, diminuendo, andante, più mosso.*

12. Write out *very distinctly* the following passage in four-pulse measure. Begin with a strong pulse. The figures show duration in pulses and fractions of a pulse:—

1	$\frac{2}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{2}$	1	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	1	$1\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$
m	**s**	**f**	**m**	**r**	**d**	**r**	**m**	**f**	**s**	**l**	**s**	**f**	**s**	**m**	**r**	**m**	**f**	rest	**t$_1$**	rest

$1\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$
l	**t$_1$**	**r**	rest	**d**	rest

THEORY OF TEACHING.

(Two and a half hours. Answer *eight* questions.)

1. Give some examples of legitimate and illegitimate forms of questioning, and give a few simple rules for the guidance of young teachers in the art of interrogation.

2. What is meant by apparatus in teaching? In dealing with what subjects, and with what cautions, should apparatus be used?

3. Why are time tables essential in a school? What should be the chief principles in constructing them?

4. How does the obedience yielded by a child in school differ from the obedience of an adult to the obligations imposed by a "sense of duty," and how can the teacher develop the one from the other?

5. Write notes of a lesson on *one* of the following:—
   (*a*) Transitive and intransitive verbs.
   (*b*) Wild flowers (*for infants*).
   (*c*) Travelling.
   (*d*) The sea.

6. In grouping together a large number of words, having in them a common element—for example, words ending in *-tion*—what generalisation could be made, and how far could scholars be helped to make the generalisation for themselves? Show the value of such an exercise.

7. In teaching history, what use would you make of dates? To what extent should chronology be taught, and how would you teach it? What mistakes are often made in teaching it?

8. Name the different purposes which should be kept in view

in the teaching of geography, and say by what means they can best be attained.

9. Show by what devices and within what limits kindergarten work can be developed in the schools for older children, and discuss the value of such development.

10. What general principles should be borne in mind in deciding on a course of physical exercises for children? What mistakes are frequently made in this matter?

11. What are the chief difficulties that arise in the teaching of grammar, and how may they be overcome?

12. How would you discover errors of hearing or vision among your children, and how would you deal with such cases when they arose?

English Language and Literature.

(Three hours. Candidates must answer not more than *six* questions, which must include at least one from each section.)

Section I.—Shakespeare's *Richard III.*

1. Explain, with context or historical illustrations, the following passages:—

(*a*) "But, God be thanked, there is no need of me—
And much I need to help you, if need were;
The royal tree hath left us royal fruit,
Which, mellowed by the stealing hours of time,
Will well become the seat of majesty,
And make, no doubt, us happy by his reign.
On him I lay what you would lay on me,
The right and fortune of his happy stars;
Which God defend that I should wring from him!"
(Act III., Sc. vii.)

(*b*) "Thy Edward he is dead, that stabbed my Edward;
Thy other Edward dead, to quit my Edward;
Young York he is but boot, because both they
Match not the high perfection of my loss.
Thy Clarence he is dead, that killed my Edward;
And the beholders of this tragic play,
The adulterate Hastings, Rivers, Vaughan, Grey,
Untimely smothered in their dusky graves."
(Act IV., Sc. iv.)

(*c*) "Ely with Richmond troubles me more near
Than Buckingham and his rash-levied strength.
Come, I have heard that fearful commenting
Is leaden servitor to dull delay;
Delay leads impotent and snail-paced beggary:
Then fiery expedition be my wing,
Jove's Mercury, and herald for a king!
Come, muster men! my counsel is my shield;
We must be brief when traitors brave the field."
(Act IV., Sc. iii.)

2. Describe the character of Richard the Third, illustrating your answer by quotations, and compare the character of Richard with that of Macbeth and of Iago.

3. What is meant by "Humphry hour"? What is a sennet? What is a basilisk? Give the meanings of the following:—Malapert, peise, fire-new, closure, pursuivant, obsequiously, sorrow breaks seasons.

4. Write short notes on the following expressions, and assign each passage to its speaker:—

(*a*) Your aery buildeth in our aery's nest.
(*b*) He is franked up to fatting for his pains.
(*c*) Within the guilty closure of the walls
Richard the Second here was hacked to death.
(*d*) And from the cross-row plucks the letter G.

Section II.

Palgrave's *Golden Treasury of Songs and Lyrics;* Scott's *Kenilworth;* Boswell's *Tour in the Hebrides;* Addison's *Sir Roger de Coverley Papers*, from the *Spectator.*

1. Show the influence of our insular position on the character of our songs.

2. Give the authors of the following quotations:—

(*a*) I could not love thee, dear, so much,
Loved I not honour more.
(*b*) To-morrow to fresh woods and pastures new.
(*c*) Drink to me only with thine eyes.
(*d*) Our sweetest songs are those that tell of saddest thought.
(*e*) Mine be a cot beside a hill.
(*f*) O say what is that thing called light
Which I must ne'er enjoy.
(*g*) The diapason closing full in man.
(*h*) Stone walls do not a prison make,
Nor iron bars a cage.

3. Give an account of Wayland *or* Varney from *Kenilworth.*

4. Give the substance of Dr. Johnson's remarks on the coining of words.

5. Write a description of Will Wimble, or of Sir Roger at church.

Section III.

1. Give some rules for the different kinds of pronouns which are frequently violated in composition.

2. Explain the meaning of the terms *synecdoche, metaphor, anti-climax,* and *redundancy,* and illustrate by examples.

3. Draw up outlines of a scheme for teaching grammar and composition simultaneously.

English History.

(Two hours. Answer *six* questions.)

1. Describe any Anglo-Saxon institutions that have survived with slight modifications down to the present time.

2. On what grounds has King Alfred the right to be styled "Alfred the Great"? Mention other monarchs that have been called "Great," and say when and where they lived.

3. State what you know of *two* of the following:—(*a*) The changes made by Henry the Second with respect to military service; (*b*) the judicial reforms of Edward the First; (*c*) the Constitutions of Clarendon; (*d*) the Doomsday Book.

4. Where are the following, and for what are they famous, in English history:—Northallerton, Runnymede, Château Gaillard, Troyes, Cyprus, Aboukir?

5. What effect had the Black Death (1348-9) on the position of the rural population in England? What statutes were enacted to deal with the altered condition?

6. Mention the decisive battles in the Wars of the Roses. What were the principal effects of these wars?

7. Trace briefly the course of the Hundred Years' War with France, mentioning its causes and results.

8. What do you know of (*a*) the Pilgrimage of Grace, and (*b*) Ket's rebellion? State clearly the causes that gave rise to them.

9. Discuss the question of "Ship-money." In what other unconstitutional ways did Charles the First raise money?

10. What circumstances made the Union between England and Scotland so urgent in the reign of Anne? Give the principal terms of the Union.

11. Give an account, with dates, of (*a*) the battle of Fontenoy; (*b*) the battle of Minden; (*c*) the capture of Quebec.

12. Why did England take part in the Peninsular War, and with what results? Give an account of the battle of Talavera *or* the siege of Badajos.

Geography.

(Two hours. Answer *seven* questions only.)

1. Describe a journey from London to Edinburgh by the East Coast route.

2. Draw a sketch-map of the basin of the Severn *or* of the basin of the Clyde, and add short notes of the points you would specially mention in giving a lesson on either.

3. Give an account of the climate of Spain and Portugal.

4. Write an account of the agriculture of Scotland.

5. Enumerate the naval ports and naval stations round the British Isles, and say what is the special purpose of each.

6. Which countries form the Triple Alliance? Compare their collective populations, and naval and military strength, with those of the Franco-Russian alliance.

7. Where are the following places, and with what events are they associated—Torres Vedras, Plevna, Sedan, Limoges, Toulon, Camperdown, and Jena.

8. Give an account of the iron and steel manufactures of the United States.

9. Say what you can about Somaliland.

10. What are the chief products of India?

11. Write an account of the Canadian Pacific Railway.

12. Give a short account of the physical features of British South Africa.

English Composition.

(One hour.)

Write an essay on one of the following:—

(*a*) "For manners are not idle, but the fruit
Of loyal nature and of noble mind."
(*b*) The plot of one of Shakespeare's comedies.
(*c*) "To live in hearts we leave behind
Is not to die."
(*d*) The recent visit of the King to the Continent.

Arithmetic.

(Three hours. All the questions may be answered. The working must be at such length as to be intelligible to the examiner. The use of algebraical methods is allowed.

1. (*a*) Define dividend, quotient, improper fraction, common multiple, number.

(*b*) Define ratio, and give three numbers which are in the inverse ratio of 2 : 3 : 4.

(*c*) Assuming that children know how to multiply by 2 and by 3, how would you teach them to multiply by 23?

2. Show that if there be no remainder, and the divisor ends in 1, 3, 7, or 9, a long division sum may be begun at the right.

3. Simplify—

$$\frac{660}{1409} \times \left\{ \frac{6\frac{3}{10}}{20} + \frac{70}{5\frac{1}{2}} - 2\frac{4}{15} \times \left(\frac{1\frac{1}{2} + 3\frac{1}{3}}{28\frac{1}{7} - 25\frac{3}{4}} \right) \div 1\frac{11}{16} \right\}.$$

4. Reduce (£7·375 − 50·$\dot{7}\dot{2}$s.) to the decimal of (£1·$\dot{4}$ − 20·$\dot{4}\dot{3}$s.).

5. Divide £100 among four persons so that their shares if increased by £1, £2 5s., £2 15s., and £4 respectively, shall be in the ratio 4 : 3 : 2 : 1.

6. A tradesman allows a discount of 4 per cent. off his list prices, and then makes a profit of 20 per cent.; what is the ratio between his cost prices and his list prices?

7. A invests £500 at 4 per cent. simple interest, and B invests £480 at 5 per cent. simple interest; after how many years will they each have the same amount?

8. Find the rent of an estate whereof $\frac{4}{15}$ are let at £2, 3s. per acre, and the remainder, consisting of 20 acres 3 roods 12 poles at £1, 16s. 8d. an acre.

9. Find how many feet and how many metres there are in ·581257 of a mile, having given that one metre equals 1·093638 yards.

10. A man invests two equal sums of money: the one bears interest at the rate of 2½ per cent. per annum, the other at the rate of 3 per cent. per annum. At the end of 5½ years he has received £18, 7s. 1½d. more from the latter investment than from the former. Find the sums of money invested.

11. Divide £47, 17s. 6½d. by ·3$\dot{7}\dot{2}$, and express in a decimal form the ratio of £143 to the quotient.

12. A man buys 45 bushels of apples at 2s. 6d. a bushel: a third of them are spoilt; of the remainder he sells one-third at 2d. a pound, and two-thirds at 4s. a bushel—a bushel of apples weighs 40 lbs. What profit does he make? And what is his profit per cent. of his outlay?

Algebra.

(Three hours. All questions may be answered.)

1. Simplify—

$$\frac{2a}{a^3 - 2} - \frac{a - 2}{a^2 - 2a + 2} - \frac{a + 2}{a^2 + 2a + 2},$$

and find the value of $a^3 - 27b^3 + 64c^3 + 36abc$ when $a + 4c = 3b$.

2. Solve the following equations:—

(1) $\frac{1}{x+1} + \frac{2}{x+2} = \frac{3}{x+3} + \frac{4}{x+4}$.

(2) $\sqrt{x+2} + \sqrt{3x+4} = \sqrt{5x+5}$.

(3) $\begin{cases} x^2 - 2xy + 2x = 1. \\ y^2 - 2xy + 2y = 1. \end{cases}$

(4) $\frac{1}{3-x} - \frac{4}{5} = \frac{1}{9-2x}$.

3. Prove that $(ab)^n = a^n b^n$, and that $(a^m)^n = a^{mn}$ when m and n are positive integers.

4. Find the fourth root of $28 + 16\sqrt{3}$.

5. Find the value of x, y, and z, such that $x + y + z = 1$, $ax + by + cz = h$, and $a^2x + b^2y + c^2z = h^2$; and show that the numerator and denominator of the value of each of these unknowns can be resolved into factors of the first degree.

6. Simplify the expression—

$$\frac{a^3}{(a-b)(a-c)} + \frac{b^3}{(b-c)(b-a)} + \frac{c^3}{(c-a)(c-b)}.$$

7. A man said to his brother, "I am twice as old as you were when I was your age, and when you are as old as I am now our united ages will be 63." Find the age of each.

8. Arrange $(ab - cd)^2 - (ac - bd)^2$ as the product of four factors.

9. If $a : b :: b : c :: c : d$, then $(a + d)(b + c) - (a + c)(b + d) = (b - c)^2$.

10. Prove that a quadratic equation cannot have more than two roots.

If p and q are the roots of the equation $ax^2 + bx + c = 0$, find the equation whose roots are pq and $\frac{1}{pq}$.

11. Show that any ratio is brought nearer to unity by adding the same quantity to both terms of the ratio. If x is a mean proportional between a and b, show that

$$\frac{1}{a^2 - x^2} + \frac{1}{b^2 - x^2} + \frac{1}{x^2} = 0.$$

12. Show that if

$$\frac{a + b + c}{a^2 + b^2 + c^2} = \frac{a^2 + b^2 + c^2}{a^3 + b^3 + c^3},$$

then each fraction is equal to

$$\frac{a(b^2 + c^2) + b(c^2 + a^2) + c(a^2 + b^2)}{2(bc + ca + ab)}.$$

General Elementary Science.

(Three hours. Answer *four* questions in Section I. and *six* questions from the other parts of the paper.)

Section I.—*Elementary Physiography.*

1. What do you mean by matter? Describe an experiment to show that matter is not destroyed by burning.

2. What do you mean by elasticity? Describe experiments to show that air is elastic, and that its elasticity changes with its temperature, the density remaining the same.

3. Describe an experiment to show that the pressure of a liquid is proportional to the depth.

4. Define a solid, and give examples of solids (*a*) which cannot be liquefied, (*b*) which pass into a gaseous state without previously melting.

5. By what means can you determine the composition of water by weight?

6. Illustrate the difference between a chemical compound and a mixture.

Section II.—*Advanced Physiography.*

1. What is meant by mechanical work? How is it measured? Find the amount of work done per hour in drawing a wagon weighing one ton along a horizontal road at a uniform rate of 4 miles an hour, the resistances being $\frac{1}{20}$ of the weight.

2. A uniform beam 7 ft. long and weighing 12 lbs. rests on two supports, one at one end and the other 1½ ft. from the other. Find the greatest weight that could be attached to the free end of the beam without tipping it up.

3. What do you mean by the centre of gravity? How may the centre of gravity of a body be found by experiment? Where is the centre of gravity of (*a*) a triangle, (*b*) a circle, (*c*) a uniform pyramid?

4. Illustrate the difference between heat and temperature. What is meant by "specific heat," and how is it determined?

5. How could you prepare a few jars of hydrogen, and what experiments could you work to show its properties?

6. Give the laws of reflection of light at a plane surface, and say how those laws are modified in the case of a convex spherical surface.

Elementary Biology.

1. Discuss the differences between an animal and a plant.

2. What functions are performed by the lowest members of the animal kingdom? Show how in the higher members special organs are charged with special work.

3. Contrast the growth and reproduction of a fern with the growth and reproduction of a flowering plant.

4. What are the functions of the root of a plant? Describe the minute rootlets of a common plant.

5. What are the functions of the leaves of a plant? How could you prove (*a*) that starch is formed in the leaves under the influence of light, and (*b*) that it passes away from the leaves at night?

6. What is meant by "cross-fertilisation"? Give instances of peculiar structures in flowers, the object of which is to ensure cross-fertilisation.

7. In what ways are young plants supplied with nourishment before they are able to obtain it for themselves from the earth and air?

8. Summarise the differences between inspired and expired air. How is respiration carried on by animals which have no lungs?

9. What is the object of the circulation of the blood? Compare the circulatory apparatus of the earth-worm, snail, frog, and rabbit.

10. Give examples of the adaptation of structure to habit in a fish, seal, sheep, bat, mole, woodpecker, and penguin.

Next month we shall begin our special course for the Certificate Examination of 1904, and as it is essential that the whole course should be followed, we strongly appeal to our readers to press upon their friends who may be taking the examination at that time the necessity for beginning at once.

OUR QUERY COLUMN.

RULES.

1. Each correspondent is restricted to *one* question.
2. Each query must be accompanied by the name and address of the correspondent, and the *coupon* which appears on the back wrapper of the current number of the Journal.
3. CORRESPONDENTS MUST IN ALL CASES STATE THE SOURCE FROM WHICH THEIR QUERY HAS BEEN OBTAINED.

The Editor reserves to himself the right to decline to answer any question which is, in his judgment, unsuited to the Magazine.

Girt.—If $\tan\left(\frac{\pi}{4}+\frac{\theta}{2}\right)=\tan^5\left(\frac{\pi}{4}+\frac{\phi}{2}\right)$, then

$$\sin\theta = 5\sin\phi\left[\frac{\left(1+\sin^2\phi\cot^2\frac{\pi}{5}\right)\left(1+\sin^2\phi\cot^2\frac{2\pi}{5}\right)}{\left(1+\sin^2\phi\tan^2\frac{\pi}{5}\right)\left(1+\sin^2\phi\tan^2\frac{2\pi}{5}\right)}\right].$$

(Cambridge Mathematical Tripos, 1885.)

Squaring both sides of the given equation, we have—

$$\tan^2\left(\frac{\pi}{4}+\frac{\theta}{2}\right)=\left\{\tan^2\left(\frac{\pi}{4}+\frac{\phi}{2}\right)\right\}^5.$$

Now $\tan^2\left(\frac{\pi}{4}+\frac{\theta}{2}\right)=\left(\frac{1+\tan\frac{\theta}{2}}{1-\tan\frac{\theta}{2}}\right)^2=\left(\frac{\cos\frac{\theta}{2}+\sin\frac{\theta}{2}}{\cos\frac{\theta}{2}-\sin\frac{\theta}{2}}\right)^2=\frac{1+\sin\theta}{1-\sin\theta}$.

Similarly, $\tan^2\left(\frac{\pi}{4}+\frac{\phi}{2}\right)=\frac{1+\sin\phi}{1-\sin\phi}$.

$$\text{Hence } \frac{1+\sin\theta}{1-\sin\theta}=\frac{(1+\sin\phi)^5}{(1-\sin\phi)^5}.$$

Adding unity to both sides, we have—

$$\frac{2}{1-\sin\theta}=\frac{(1+\sin\phi)^5+(1-\sin\phi)^5}{(1-\sin\phi)^5}.$$

$$\therefore 1-\sin\theta=\frac{2(1-\sin\phi)^5}{(1+\sin\phi)^5+(1-\sin\phi)^5}.$$

$$\therefore \sin\theta=1-\frac{2(1-\sin\phi)^5}{(1+\sin\phi)^5+(1-\sin\phi)^5}$$

$$=\frac{(1+\sin\phi)^5-(1-\sin\phi)^5}{(1+\sin\phi)^5+(1-\sin\phi)^5}.$$

Hence, on expanding and collecting terms, we have—

$$\sin\theta=\frac{10\sin\phi+20\sin^3\phi+2\sin^5\phi}{2+20\sin^2\phi+10\sin^4\phi}.$$

$$\therefore \sin\theta=5\sin\phi\left[\frac{1+2\sin^2\phi+0{\cdot}2\sin^4\phi}{1+10\sin^2\phi+5\sin^4\phi}\right].$$

$$\cot^2\frac{\pi}{5}=\frac{5+2\sqrt{5}}{5},\ \tan^2\frac{\pi}{5}=5-2\sqrt{5};$$

$$\cot^2\frac{2\pi}{5}=\frac{5-2\sqrt{5}}{5},\ \tan^2\frac{2\pi}{5}=5+2\sqrt{5}.$$

$$\therefore \frac{\left(1+\sin^2\phi\cot^2\frac{\pi}{5}\right)\left(1+\sin^2\phi\cot^2\frac{2\pi}{5}\right)}{\left(1+\sin^2\phi\tan^2\frac{\pi}{5}\right)\left(1+\sin^2\phi\tan^2\frac{2\pi}{5}\right)}$$

$$=\frac{\{1+\sin^2\phi(1+0{\cdot}4\sqrt{5})\}\{1+\sin^2\phi(1-0{\cdot}4\sqrt{5})\}}{\{1+\sin^2\phi(5-2\sqrt{5})\}\{1+\sin^2\phi(5+2\sqrt{5})\}}$$

$$=\frac{1+2\sin^2\phi+0{\cdot}2\sin^4\phi}{1+10\sin^2\phi+5\sin^4\phi}.$$

$$\text{Hence } \sin\theta=5\sin\phi\left[\frac{\left(1+\sin^2\phi\cot^2\frac{\pi}{5}\right)\left(1+\sin^2\phi\cot^2\frac{2\pi}{5}\right)}{\left(1+\sin^2\phi\tan^2\frac{\pi}{5}\right)\left(1+\sin^2\phi\tan^2\frac{2\pi}{5}\right)}\right].$$

Ethelbert.—Find the positive values of θ, less than 180°, which satisfy the equation $4\sin\theta\cos 2\theta=1$.

(S.K., Stage 3, 1898.)

Since $4\sin\theta\cos 2\theta=1$,

$$\therefore 2(2\sin\theta\cos\theta)\cos 2\theta=\cos\theta.$$

$$\therefore 2\sin 2\theta\cos 2\theta=\cos\theta.$$

$$\therefore \sin 4\theta=\cos\theta.$$

$$\therefore \sin 4\theta=\sin\left(\frac{\pi}{2}-\theta\right).$$

$$\text{Hence } \sin 4\theta-\sin\left(\frac{\pi}{2}-\theta\right)=0.$$

$$\therefore 2\cos\left(\frac{3\theta+\frac{\pi}{2}}{2}\right)\sin\left(\frac{5\theta-\frac{\pi}{2}}{2}\right)=0.$$

(i) If $\cos\left(\frac{3\theta+\frac{\pi}{2}}{2}\right)=0$,

$$\text{then } \frac{3\theta+\frac{\pi}{2}}{2}=(2n+1)\frac{\pi}{2}.$$

$$\therefore 3\theta+\frac{\pi}{2}=(2n+1)\pi.$$

$$\therefore 3\theta=(4n+1)\frac{\pi}{2}.$$

$$\therefore \theta=(4n+1)\frac{\pi}{6}.$$

$$\therefore \theta=\frac{\pi}{6},\ \frac{5\pi}{6},\ \frac{9\pi}{6},\ \text{etc.}$$

(ii) If $\sin\left(\frac{5\theta-\frac{\pi}{2}}{2}\right)=0$,

$$\text{then } \frac{5\theta-\frac{\pi}{2}}{2}=n\pi.$$

$$\therefore 5\theta=2n\pi+\frac{\pi}{2}=(4n+1)\frac{\pi}{2}.$$

$$\therefore \theta=(4n+1)\frac{\pi}{10}.$$

$$\therefore \theta=\frac{\pi}{10},\ \frac{\pi}{2},\ \frac{9\pi}{10},\ \text{etc.}$$

Hence the positive values of θ less than π which satisfy the given equation are

$$\frac{\pi}{10},\ \frac{\pi}{6},\ \frac{5\pi}{6},\ \text{and}\ \frac{9\pi}{10}.$$

Or we may take from the equation

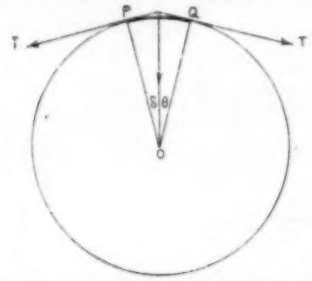
$$\sin 4\theta=\sin\left(\frac{\pi}{2}-\theta\right),$$

the relation $\frac{\pi}{2}-\theta=m\pi+(-1)^m 4\theta$.

Hence giving to m integral values between -4 and 3, we obtain the same *positive* values for θ as before.

Arum.—Determine the greatest velocity in miles an hour possible with wheel tyres of density 1 cwt./ft.^{3} and tensile strength 2 cwt./in.^{2} (London B.Sc., 1902.)

Where can I see a discussion of this subject?



Let O be the centre of the axle, and PQ a short length of the tyre subtending an angle $(\delta\theta)$ at O. The stresses at P and Q in the directions of the tangents at these points are obviously equal to one another. Let each be denoted by T in pounds. Then their resultant is given by $2T \sin\left(\frac{\delta\theta}{2}\right)$ pounds, and this, when the angle $\delta\theta$ is small, is approximately $2T\left(\frac{\delta\theta}{2}\right)$ pounds—that is, $T(\delta\theta)$ pounds.

But this resultant is equal to the centripetal force due to which PQ rotates about O. Hence, if V denotes the greatest linear velocity in feet per second which a point in the tyre may have, then

$$T(\delta\theta) = \frac{W}{g}\frac{V^2}{r}, \quad \ldots\ldots\ldots \quad (1)$$

where W is the weight of PQ in pounds and r is the radius of the wheel in feet.

Now the radian measure of the angle $POQ = \frac{s}{r}$, where s is the length of PQ in feet. Therefore $(\delta\theta) = \frac{s}{r}$.

Let a represent the cross-section of the tyre in square feet. Then, from the data of question, we have—

$W = s \,.\, a \,.\, 112$ lbs., and $T = 224(a \times 144)$ lbs.

Hence (1) becomes

$$224 \,.\, a \,.\, 144 \,.\, \frac{s}{r} = \frac{s \,.\, a \,.\, 112}{g}\frac{V^2}{r}.$$

$$\therefore V^2 = 2 \times 144g = 2 \times 144 \times 32.$$

$$\therefore V = 96 \text{ feet per second.}$$

Since the linear velocity of O is half that of a point on the tyre, it follows that the greatest velocity possible for O is 48 feet per second—that is, *nearly thirty-three miles an hour.*

See Unwin's *Machine Design* (Longmans), Part I., § 278, or Part II., § 198.

Redder.—A pulley carrying a load W is hung in a loop of a cord which passes over two fixed pulleys, and has weights P and Q freely suspended from its ends, each segment of the cord being vertical. Show that when the system is let go W will remain at rest, or move with uniform velocity, provided that

$$\frac{1}{P} + \frac{1}{Q} = \frac{4}{W},$$

and there is no friction anywhere.

(Inter. Science, London, 1899.)

From the given relation

$$\frac{1}{P} + \frac{1}{Q} = \frac{4}{W},$$

we have

$$\frac{P + Q}{PQ} = \frac{4}{W}.$$

$$\therefore \frac{2PQ}{P + Q} = \frac{W}{2}.$$

Now, at any instant let T be the tension of the cord. Then, as shown in any treatise on dynamics,

$$T = \frac{2PQ}{P + Q}. \quad \therefore T = \frac{W}{2}.$$

Now the only forces acting on W are its weight W, acting vertically downwards, and the tensions in either branch of the loop, each equal to $\frac{W}{2}$, and acting vertically upwards. Hence the resultant force acting on W is zero, and therefore the body will remain at rest or move with uniform velocity.

Sha.—Show how to differentiate the integral $I = \int_a^b \phi(x, a)dx$ with respect to a, when the limits a, b are functions of a, and prove that—

$$1. \int_0^\infty e^{-\beta x}\frac{\sin a x}{x}dx = \tan^{-1}\frac{a}{\beta}.$$

$$2. \int_0^a \cosh^{-1}\left(\frac{\cos x}{\cos a}\right)dx = \tfrac{1}{2}\pi \log \sec a.$$

(Mathematical Honours, B.Sc., Victoria, 1900.)

For the first part of question, see any modern work on the Integral Calculus—for example, Williamson's *Integral Calculus*, § 114, pp. 147–48.

1. Williamson's *Integral Calculus*, p. 145, Equation 31, gives—

$$\int_0^\infty e^{-\beta x}\cos a x\,dx = \frac{\beta}{a^2 + \beta^2}.$$

Integrate both sides with respect to a.

$$\therefore \int_0^\infty e^{-\beta x}\frac{\sin a x}{x}dx = \tan^{-1}\frac{a}{\beta}.$$

2. Let $\int_0^a \cosh^{-1}\left(\frac{\cos x}{\cos a}\right)dx = u.$

$$\therefore \frac{du}{da} = \int_0^a \frac{d}{da}\left[\cosh^{-1}\left(\frac{\cos x}{\cos a}\right)\right]dx + \cosh^{-1}\left(\frac{\cos a}{\cos a}\right)$$

$$= \int_0^a \frac{1}{\sqrt{\left[\frac{\cos^2 x}{\cos^2 a} - 1\right]}}\sec a \,.\, \tan a \,.\, \cos x \,.\, dx + 0$$

$$= \int_0^a \frac{\tan a \,.\, \cos x}{\sqrt{(\cos^2 x - \cos^2 a)}}dx$$

$$= \left[\tan a \,.\, \sin^{-1}\left(\frac{\sin x}{\sin a}\right)\right]_0^a$$

$$= \frac{\pi}{2} \,.\, \tan a.$$

$$\therefore u = \frac{\pi}{2}\int \tan a \,.\, da$$

$$= \frac{\pi}{2}\log \sec a + C.$$

But as $u = 0$ when $a = 0$, $\therefore C = 0$.

$$\therefore \int_0^a \cosh^{-1}\left(\frac{\cos x}{\cos a}\right)dx = \frac{\pi}{2}\log \sec a.$$

Kindly refer to Rule 1.

St. Xavier.—A tradesman's expenses are 12 per cent. on his net receipts, and he allows his customers 5 per cent. off their bills for cash payment. How much above cost price ought he to mark his selling price so as to make 10 per cent. on his money laid out in goods?

(School Final Examination, University of Bombay.)

For goods marked at £1 as selling price his net receipts amount to £0·95. Of this he will have 0·88 × £0·95 left after payment of expenses at the rate of 12 per cent. thereon. Since he is to gain 10 per cent. on the money laid out, this last sum must be $\frac{11}{10}$ of the money laid out. Therefore the cost price of goods whose selling price is marked at £1 must have been $\frac{11}{10} \times 0{\cdot}88 \times$ £0·95 or £0·76.

Hence goods whose cost price was £0·76 will be marked for sale at £1.

Therefore goods whose cost price was £76 will be marked for sale at £100.

Therefore goods whose cost price was £100 will be marked for sale at £$\frac{100}{76}$.

Since £$\frac{100}{76}$ = £$\frac{25}{19}$ = £131$\frac{1}{19}$, it follows that goods must be marked for sale at 31$\frac{1}{19}$ per cent. above the cost price.

Bat.—A secant of a conic section is drawn through a given point A to meet the conic in Q and R. Find the locus of B, a point upon the secant, when the four points A, B, Q, R form a harmonic range.

In any treatise on analytical geometry it is shown that if a secant through A meets a conic in Q and R and *the polar of* A in B, then AQ, AB, AR are in harmonic progression. (See, for example, Johnston's *Analytical Geometry*, § 308.) Hence the locus of B is the polar of A.

P.E.D.M.—Two balls, weighing W_1 and W_2 lbs. respectively, are connected by a thread a feet long; and W_1 is held in the hand while W_2 is whirled round. Determine the motion which ensues if W_1 is released from rest when W_2 is moving with velocity V at inclination θ; and prove that in the air the tension of the thread is

$$\frac{W_1W_2}{W_1+W_2}\cdot\frac{V^2}{ga}\text{ lbs.}$$

(Intermediate Science, London, 1902.)

When W_1 is let go the centre of mass of the system will have a motion compounded of its motion tangential to circle in which it was moving before W_1 was let go, and the motion due to gravity. The centre of mass will therefore describe a parabola. Further, the system will revolve about the vertical line through its centre of mass with the same angular velocity as before.

The centre of mass of the system divides the length of the thread into two parts, whose lengths are inversely proportional to the masses at their extremities. Hence the mass W_1 is distant $\frac{W_2}{W_1+W_2}\cdot a$ from the centre of mass of the system. W_1 will therefore move about the vertical through the centre of mass with a linear velocity $\frac{W_2}{W_1+W_2}V$. Hence W_1 moves under the action of a centripetal force of $\frac{W_1}{g}\left(\frac{W_2}{W_1+W_2}\cdot V\right)^2\cdot\frac{1}{r}$ lbs., where r is the perpendicular distance of W_1 from the vertical through the centre of mass of the system. Therefore $r=\frac{W_2}{W_1+W_2}\cdot a\sin\theta$. Hence W_1 moves about the vertical through the centre of mass of the system under the action of a centripetal force

$$\frac{W_1}{g}\left(\frac{W_2}{W_1+W_2}\cdot V\right)^2\cdot\frac{1}{\frac{W_2}{W_1+W_2}\cdot a\sin\theta}\text{ lbs.,}$$

and the resolved part of this in the direction of the thread is

$$\frac{W_1}{g}\left(\frac{W_2}{W_1+W_2}V\right)^2\frac{1}{\frac{W_2}{W_1+W^2}\cdot a\sin\theta}\cdot\sin\theta\text{ lbs.}$$

The last expression reduces to $\frac{W_1}{g}\cdot\frac{W_2}{W_1+W_2}\frac{V^2}{a}$ lbs.; therefore the tension of the thread after the system is let go is equal to $\frac{W_1W_2}{W_1+W_2}\cdot\frac{V^2}{ga}$ lbs.

P.E.D.M.—A funnel in the shape of a symmetrical double cone with communication at the vertex is fitted watertight on a horizontal plane and filled with liquid. Prove that liquid will escape unless the funnel is weighted to double the weight of the liquid. (Inter. Science, London, 1902.)

The normal fluid pressure upon the convex surface of the upper cone is equal to the weight of a column of fluid whose base is equal to the area of the convex surface of the cone, and whose height is equal to the depth of the centre of the convex surface of the cone below the free surface of the liquid. Now, since the convex surface of the cone may be regarded as made up of an infinite number of triangles having their common vertex coincident with the vertex of the cone, and their bases in the circumference of the base of the cone, it follows that the centre of area of the convex surface of the cone will be at the distance of one-third of the height of the cone from its base. Hence the normal fluid pressure upon the convex surface of the upper cone will be equal to $2\pi r\frac{s}{2}\frac{h}{3}\sigma$, where r is the radius of the base, h the vertical height, and s the slant height of the cone, and σ the specific gravity of the liquid.

Resolving this resultant pressure vertically and horizontally, its vertical component is $\pi rs\frac{h}{3}\sigma\times\frac{r}{s}=\frac{1}{3}\pi r^2h\sigma$, acting *downwards*.

Similarly, we may show that the vertical component of the resultant pressure on the convex surface of the lower cone is equal to $\frac{5}{3}\pi r^2h\sigma$ acting *upwards*.

The vertical component of the resultant thrust of the liquid on the total convex surface is therefore $\frac{5}{3}\pi r^2h\sigma-\frac{1}{3}\pi r^2h\sigma$, or $\frac{4}{3}\pi r^2h\sigma$ acting upwards.

Now the weight of the liquid is equal to $2\left(\pi r^2\frac{h}{3}\sigma\right)$, which is just half of the resultant upward thrust of the liquid on the convex surface.

Ex.—The electrostatic capacity per nautical mile of a gutta-percha cable is found to be

$$\frac{0{\cdot}18769}{\log\frac{D}{d}}\text{ farads,}$$

and the resistance of its insulating sheath

$$\frac{\log\frac{D}{d}}{13}\times10^6\text{ ohms.}$$

Calculate the time of falling to half-charge (give $\log 2=0{\cdot}6931471$).

Ans. 2 hrs. 46 min. nearly.

Find from the result the time of falling to half-charge in a condenser of Hooper's material, given that its resistance is sixteen times that of gutta-percha, and its specific inductive capacity $\frac{31}{42}$ of that of gutta-percha. Ans. 32 hrs. 48 min.

(Cumming's *Theory of Electricity*, chap. ix.)

At any instant let V be the P.D., in volts, between the two coatings of the condenser, and let Q be the charge in coulombs. Then, if K is the capacity of the condenser in farads, we have

$$K=\frac{Q}{V}.\quad\therefore V=\frac{Q}{K}.$$

If R is the resistance, in ohms, between the plates of the condenser, the current will, by Ohm's law, be equal to $\frac{V}{R}$ in ampères.

But the current is also equal to $-\frac{dQ}{dt}$, or the rate of diminution of the charge per second. Thus

$$-\frac{dQ}{dt}=\frac{V}{R}=\frac{Q}{KR}.\quad\therefore\frac{dQ}{dt}+\frac{Q}{KR}=0.$$

The solution of this differential equation is given by

$$\log_e Q=A-\frac{t}{KR},$$

where A is an arbitrary constant.

Let the charge Q be equal to Q_1 at a time $t=t_1$, while at the time $t=t_2$ the charge has fallen to half its value, or $Q=\frac{Q_1}{2}$. Then, if $t_2-t_1=T$,

$$\log_e Q_1=A-\frac{t_1}{KR}.$$

$$\log_e\frac{Q_1}{2}=A-\frac{t_2}{KR}.$$

$$\therefore\log_e Q_1-\log_e\frac{Q_1}{2}=\log_e\left(Q_1\Big/\frac{Q_1}{2}\right)=\log_e 2=\frac{t_2-t_1}{KR}=\frac{T}{KR}.$$

$$\therefore T=KR\log_e 2.$$

Let l be the length of the cable in nautical miles. Then the capacity K will be directly proportional to l, while the resistance will be inversely proportional to l.

$$\therefore T=\frac{l\times0{\cdot}18769}{\log\frac{D}{d}}\times\frac{\log\frac{D}{d}}{13l}\times10^6\times0{\cdot}6931471$$

$$=\frac{0{\cdot}18769}{13}\times0{\cdot}693147\times10^6=1{\cdot}001\times10^4\text{ secs.}$$

$$=2\text{ hrs. }46\text{ min. }50\text{ sec.}$$

For second part of question, note that the time of falling to half-charge is proportional to the product of KR. In the case of Hooper's material, the product KR is

$$\frac{16\times31}{42}=\frac{248}{21}$$

times as great as for gutta-percha. Thus the time of falling to half-charge will be $\frac{248}{21}$ times as great, and will amount to $1{\cdot}182\times10^5$ secs. = 32 hrs. 50 min.

Bat.—If a light is placed at E, the upper end of the vertical diameter AE of the circle on which the plummet oscillates, to throw the shadow T of the plummet on the floor, moving from F to F′, and if TR is the ordinate of the circle on the diameter FF′, prove that the velocity of R varies as ET, and fluctuates between

$$\tfrac{1}{2}\mathrm{FF}'\sqrt{\frac{g}{l}} \text{ and } \tfrac{1}{2}\mathrm{FF}'\cos\frac{a}{2}\sqrt{\frac{g}{l}},$$

2a denoting the angle of oscillation, not restricted to be small; and thence show that the period of oscillation lies between

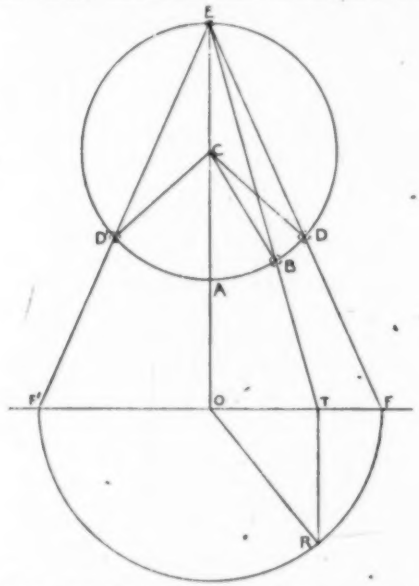
$$2\pi\sqrt{\frac{l}{g}} \text{ and } 2\pi\sec\frac{a}{2}\sqrt{\frac{l}{g}}.$$

(London B.Sc., 1902.)

The above problem, if correctly copied, is scarcely up to the usual standard. In the first place, the limiting values of the velocity of R are incorrectly stated. Further, the expression, "The velocity of R varies as ET," would generally be understood to mean that the velocity of R is *directly proportional* to ET, which is not the case; as a matter of fact, the velocity of R is a *function* of ET, that function being approximately linear only when the angle of oscillation is small.

The following is the solution of the problem:—

Let the plummet B be joined to the end of a massless



cord CB, of length l, the end C of this cord being fixed, while the plummet is free to oscillate on the circumference of the circle EDAD, of radius l, D and D′ being the extremities of its excursions. Let the light at E throw the shadow of the plummet, when at D, on to the floor at F, while the shadow has the position F′ when the plummet is at D′. Draw the vertical diameter EAO. O will be the centre of the excursion performed by the shadow. Let $\angle \mathrm{DCA} = \angle \mathrm{D'CA} = a$, in which case $\angle \mathrm{DEA} = \angle \mathrm{D'EA} = \frac{a}{2}$; and let OF, the amplitude of the excursion of the shadow, be equal to a. When the plummet is at B, let its shadow be at T, and let $\angle \mathrm{BCA} = \theta$, in which case $\angle \mathrm{BEA} = \frac{\theta}{2}$; also let $\mathrm{OT} = x$. From T draw TR perpendicular to OF, so as to cut the circle FRF′, described on FF′ as diameter, at R. Join OR, and let $\angle \mathrm{ROF} = \phi$. Then, if $\mathrm{EO} = b$, we shall have—

$$\begin{aligned}\mathrm{OT} &= \mathrm{EO}\tan\mathrm{TEO} = b\tan\frac{\theta}{2}\\ &= \mathrm{OR}\cos\mathrm{TOR} = a\cos\phi.\\ \therefore\ a\cos\phi &= b\tan\frac{\theta}{2}. \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)\end{aligned}$$

Differentiating both sides of (1) with respect to t, we have—

$$-a\sin\phi\,\frac{d\phi}{dt} = \frac{b}{2}\cdot\frac{1}{\cos^2\frac{\theta}{2}}\cdot\frac{d\theta}{dt}. \quad . \quad . \quad . \quad . \quad (2)$$

Now, $a\frac{d\phi}{dt}$ is equal to the required instantaneous velocity of R. Further, $a\sin\phi = \mathrm{OR}\sin\mathrm{TOR} = \mathrm{TR} = \sqrt{\mathrm{OR}^2 - \mathrm{OT}^2} = (a^2 - x^2)^{\frac{1}{2}}$.

From similar reasoning, $-l\frac{d\theta}{dt}$ is equal to the instantaneous velocity of the plummet when at B. Let this velocity be equal to v. Then, while the plummet moved from D to B, it must have fallen through a vertical distance equal to $l(\cos\theta - \cos a)$, its potential energy being thereby diminished by $mgl(\cos\theta - \cos a)$, where m is the mass of the plummet, and g is the acceleration due to gravity. By the law of conservation of energy, the kinetic energy $\frac{1}{2}mv^2$ gained by the plummet must be equal to the potential energy lost. Therefore $\frac{1}{2}mv^2 = mgl(\cos\theta - \cos a)$.

Dividing both sides by $\frac{m}{2}$, and remembering that

$$\cos\theta - \cos a = (1 - \cos a) - (1 - \cos\theta) = 2\sin^2\frac{a}{2} - 2\sin^2\frac{\theta}{2},$$

we have—

$$v^2 = 4gl\left(\sin^2\frac{a}{2} - \sin^2\frac{\theta}{2}\right).$$

$$\therefore\ v = -l\frac{d\theta}{dt} = 2\sqrt{gl}\left(\sin^2\frac{a}{2} - \sin^2\frac{\theta}{2}\right)^{\frac{1}{2}}.$$

$$\therefore\ \frac{d\theta}{dt} = 2\sqrt{\frac{g}{l}}\left(\sin^2\frac{a}{2} - \sin^2\frac{\theta}{2}\right)^{\frac{1}{2}}.$$

Substituting in (2), we obtain—

$$-(a^2 - x^2)^{\frac{1}{2}}\frac{d\phi}{dt} = -\frac{b}{2}\cdot\frac{1}{\cos^2\frac{\theta}{2}}\cdot 2\sqrt{\frac{g}{l}}\cdot\left(\sin^2\frac{a}{2} - \sin^2\frac{\theta}{2}\right)^{\frac{1}{2}}.$$

Also, $\dfrac{b}{\cos\frac{\theta}{2}} = \dfrac{\mathrm{EO}}{\cos\mathrm{TEO}} = \mathrm{ET}$, and $\mathrm{ET}\sin\frac{\theta}{2} = \mathrm{OT} = x$.

$$\therefore\ (a^2 - x^2)^{\frac{1}{2}}\frac{d\phi}{dt} = \frac{\mathrm{ET}}{\cos\frac{\theta}{2}}\left(\sin^2\frac{a}{2} - \sin^2\frac{\theta}{2}\right)^{\frac{1}{2}}\sqrt{\frac{g}{l}}$$

$$= \frac{1}{\cos\frac{\theta}{2}}\left((\mathrm{ET})^2\sin^2\frac{a}{2} - (\mathrm{ET})^2\sin^2\frac{\theta}{2}\right)^{\frac{1}{2}}\sqrt{\frac{g}{l}}$$

$$= \frac{1}{\cos\frac{\theta}{2}}\left\{\left(\frac{\mathrm{ET}}{\mathrm{EF}}\right)^2(\mathrm{EF})^2\sin^2\frac{a}{2} - (\mathrm{ET})^2\sin^2\frac{\theta}{2}\right\}^{\frac{1}{2}}\sqrt{\frac{g}{l}}$$

$$= \frac{1}{\cos\frac{\theta}{2}}\left\{\left(\frac{\mathrm{ET}}{\mathrm{EF}}\right)^2\cdot a^2 - x^2\right\}^{\frac{1}{2}}\sqrt{\frac{g}{l}}.$$

$$\therefore\ a\frac{d\phi}{dt} = \frac{a}{\cos\frac{\theta}{2}}\cdot\frac{\left[\left(\frac{\mathrm{ET}}{\mathrm{EF}}\right)^2a^2 - x^2\right]^{\frac{1}{2}}}{(a^2 - x^2)^{\frac{1}{2}}}\sqrt{\frac{g}{l}}$$

$$= \frac{a\,.\,\mathrm{ET}}{b}\cdot\frac{\left[\left(\frac{\mathrm{ET}}{\mathrm{EF}}\right)^2a^2 - x^2\right]^{\frac{1}{2}}}{(a^2 - x^2)^{\frac{1}{2}}}\sqrt{\frac{g}{l}}.$$

Thus the velocity of R is a function of the length ET. When $x = 0$ (that is, as the shadow of the plummet passes through the point O), ET becomes equal to $\mathrm{EO}\,(= b)$, and we have—

$$v = \frac{a\,.\,\mathrm{EO}}{b}\cdot\frac{\mathrm{EO}}{\mathrm{EF}}\sqrt{\frac{g}{l}}$$

$$= a\cos\frac{a}{2}\sqrt{\frac{g}{l}}.$$

As x approaches the value a, ET approaches the value EF, so that

$$\frac{\left[\left(\frac{\mathrm{ET}}{\mathrm{EF}}\right)^2a^2 - x^2\right]^{\frac{1}{2}}}{(a^2 - x^2)^{\frac{1}{2}}}$$

approaches the value unity. In this case

$$v = \frac{a\,.\,\mathrm{ET}}{b}\sqrt{\frac{g}{l}} = \frac{a}{\cos\frac{a}{2}}\sqrt{\frac{g}{l}}$$

$$= a\sec\frac{a}{2}\sqrt{\frac{g}{l}}.$$

Thus the velocity fluctuates between the limits

$$a\cos\frac{a}{2}\sqrt{\frac{g}{l}} \text{ and } a\sec\frac{a}{2}\sqrt{\frac{g}{l}}.$$

Let T be the time of a complete oscillation of the shadow T. In this time we may suppose that the point R travels once round the circle of which FRF′ is one-half, and covers a distance equal to $2\pi a$. Thus the average velocity of R is equal to

$$\frac{2\pi a}{T} > a \cos\frac{a}{2}\sqrt{\frac{g}{l}}$$

$$< a \sec\frac{a}{2}\sqrt{\frac{g}{l}}.$$

∴ T lies between

$$2\pi \sec\frac{a}{2}\sqrt{\frac{l}{g}} \text{ and } 2\pi \cos\frac{a}{2}\sqrt{\frac{l}{g}}.$$

S.R.S.—Professor S. P. Thompson's *Electricity and Magnetism* is scarcely the book which we should recommend to a student preparing for the London Matriculation Examination under the new regulations. Though a thoroughly good book, sufficient stress is not laid on some of the more elementary parts of the subject, while much might be left out, and in some cases a supplementary work would be required. To indicate the parts which you should read would take too much space for this column. We should recommend you to obtain Hadley's *Magnetism and Electricity for Beginners* (Macmillan and Co.), in which you will find the subject arranged according to your requirements.

Scientia.—A point is describing a circle of radius seven yards in eleven seconds, starting from the end of a fixed diameter and moving with uniform speed. Find the change in its velocity after it has described one-sixth of the circumference.

(Loney's *Elementary Dynamics*, pp. 15, 16.)

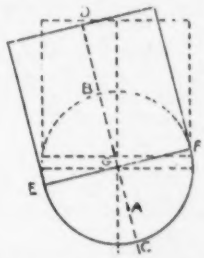
In this problem the *numerical magnitude* of the velocity of the point remains constant, while the *direction* of motion continually changes. Numerically the velocity of the point is equal to $\frac{7 \times 3}{11} = \frac{21}{11}$ feet per second, and the direction of motion will always be tangential to the circle described, touching the latter at the position occupied by the point. While the point describes one-sixth of the circumference, the direction of motion changes by 60°. Hence, if we draw from the starting-point a straight line equal to $\frac{21}{11}$ and parallel to the initial direction of motion, and then, from the same point, draw another line equal in length to $\frac{21}{11}$, but parallel to the direction of motion after the point has described one-sixth of the circumference, we shall have two equal straight lines inclined to each other at an angle of 60°. If we join the free extremities of these lines by a straight line, the length of this line, measured from the extremity of the first to the extremity of the second, will give us the velocity which, if added vectorially to the original velocity, will produce the final velocity. Since the triangle formed is obviously equilateral, the change in the velocity of the point is equal to $\frac{21}{11}$ feet per second, in a direction inclined at an angle of 120° to the original velocity.

Garth.—What is the nature of lightning? What should be the arrangement for a good lightning-conductor? How should it act?

In certain circumstances the particles of water forming a cloud become electrically charged, when the cloud virtually forms one plate of a condenser, of which the earth forms the other plate. When the difference of potential between the cloud and the earth reaches a sufficiently high value, the tension of the lines of force in the air becomes so great that its insulating properties break down, and a spark is formed. This spark is what we term lightning.

A good lightning-conductor should, in the first place, tend to prevent a high potential difference arising between the cloud and the earth. This end will generally be secured if the upper end of the conductor is provided with one or more sharp points, at which brush discharges may be formed, the lower end of the conductor being buried in a wet part of the ground, so as to form a good connection with the earth. In the second place, if a high potential difference does occur between the cloud and the earth, the discharge should take place between the cloud and the end of the conductor, and should reach the earth without passing through any portion of the building which is to be protected. Thus the conductor should consist of a continuous metallic wire or strip which is not electrically connected with any conducting part of the building, such as gas-pipes, bell-wires, etc. The lightning-conductor should preferably be made from a strip of copper, and in fastening it to the building sharp angular bends should be avoided as much as possible, since the inertia of the electrical discharge will sometimes cause it to take a badly conducting path, if this be straight, in preference to a better conducting path which is looped or bent.

Bryu.—Prove that a tumbler of thin glass, composed of a cylindrical part and a hemispherical base, will stand upright on a table if the height does not exceed the diameter; and that liquid poured in will not disturb the equilibrium before it reaches the cylindrical part.



The centre of gravity of a hemispherical shell is at a point A, where $A = \frac{1}{2}CG$. Similarly the centre of gravity of the cylinder is at a point B, where $GB = \frac{1}{2}GD$.

So long as the height of the cylinder is less than the radius CG, the surface of the cylinder is less than that of the hemisphere, and the centre of gravity of the combined cylinder and hemisphere will be below EF (the base of the hemisphere). When the height of the cylinder is made equal to the radius GC, the surface of the cylinder is equal to that of the shell, and the centre of gravity bisects the line joining B to A—that is, is on the line EF. Hence the equilibrium is neutral. If the height of the cylinder be increased, G will be above EF, and the system will be in a state of unstable equilibrium.

To ascertain the effect produced when water is poured in, we may imagine the sphere completed, as indicated by the dotted lines. Then, when the axis is displaced through a small angle, the surface of the water will lie inside the sphere until the surface of the water reaches the line EF. When the surface of the water is above the line EF, the tilting of the axis will cause a portion of the liquid to fall outside the sphere, as indicated by the small shaded area, and this renders the system unstable.

Nan.—The maximum distance of distinct vision for a certain person is 20 cms. To enable him to see distant objects distinctly he will require a lens. Calculate either (*a*) the power in *dioptries* of that lens, or (*b*) its focal length in centimetres. Explain also, with the aid of a diagram, why this lens will enable him to have distant vision. (London, Inter. Science, 1899.)

The chamber of the normal eye is of such an axial length that when rays initially parallel are refracted through the lens system of the eye, they are brought to a focus on the retina. In terms of the wave theory, we may say that when the eye is of normal length a plane light wave from a distant object will converge, after refraction by the lens system, to a point on the retina. If the greatest distance of distinct vision for a particular person is equal to 20 cms., his eye must be abnormally long, so that parallel rays are brought to a focus within the chamber of the eye before reaching the retina; or plane waves, after refraction, converge toward a point in front of the retina. In order that the person should see distant objects distinctly, the parallel rays from a distant object must be caused, by the aid of a lens, to apparently diverge from a point 20 cms. in front of the eye. But parallel rays, after refraction through a lens, converge toward, or apparently diverge from, the second focal point of the lens. Let the lens be placed very close to the eye. Then, since it is necessary that the transmitted rays shall apparently diverge from a point 20 cms. in front of the lens, and since this point is to be the second focal point of the lens, the focal length (that is, distance from lens to second focal point) must be equal to + 20 cms. Thus the lens must be divergent. To find the power in dioptries (or dioptres), we must change the sign of the focal length, express the latter in metres, and then obtain its reciprocal. Thus the power of the required lens is equal to $-\frac{1}{-2} = -5$ dioptres.

(For diagram and further details, see *Light for Students*, by E. Edser, pp. 188 and 74.)

The following solutions can be obtained by post on application—*Arum, Olympus, G.M.V., Quo Modo, Duty, Aurora, Matric, A. Gilroy, Ralpho, Chaos, J. Dier, A. E. Hall, Spero, Crocky, Duncan D. Hair, Bike, Civis.*

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PHYSIOGRAPHY.

(ADVANCED AND HONOURS.)

The Depth of Glaciers.—Ever since Professor Tyndall first discovered the movement of glaciers, attempts have been made by scientists to ascertain the exact depth of these natural phenomena by boring. Their efforts, however, have not been attended with very conspicuous success, owing to mechanical difficulties that have been encountered. But Professors Blumcke and Hess of Bavaria, who are well known for their studies of glaciers, have succeeded in boring through the Hintereis glacier in the Otzthal Alps, and found the ice to be 153 inches deep. The machine used for boring was driven by hand, and somewhat resembled that usually employed for experimental boring in mines, but was fitted with special arrangements for washing out fragments of ice from the bore hole, to prevent them from freezing together again. The expenses of the investigation were defrayed by the German and Austrian Alpine clubs.

Solar Prominences.—Dr. W. J. S. Lockyer has made an investigation to find whether solar prominences follow any law analogous to that which obtains with regard to sun-spots, which, as is well known, appear at the beginning of a period in high latitudes, and then, as the period goes on, accumulate in regions nearer the solar equator. The observations of prominences made by Professor Tacchini at Rome, and by Professors Ricco and Mascari at Catania, were available for discussion, and from these the percentage and frequency of prominence activity for every ten degrees of solar latitude were computed and plotted for each year. From these curves the author concludes that the centres of action of prominence activity undergo an apparently regular variation, and that the directions of motion of these centres is from low to high latitudes, the reverse of that of spot regions.

Mention may be made here of a small research by M. Mascari, from which he arrives at the conclusion that solar prominences and faculæ are two distinct and completely independent phenomena.

The Zodiacal Light.—Writing to the *Journal* of the British Astronomical Association on some remarks as to the rarity of this phenomenon being seen in inland English towns, Mr. Alf. Watson gives the following account of two observations made by himself at his observatory on the slope of the Malvern Hills. Directly after 7.15 on the evening of February 21, an indefinite glow spread itself obliquely upwards, just skirting γ Pegasi, up through Pisces and Aries, nearly to the Pleiades. At 7.30 the appearance was very pleasing, and traces of it could be seen till nearly 9 p.m.

The second occasion was on the following Saturday, February 28th, on which day the phenomenon was repeated, the details being similar but not quite so clear. The colour of the light, adds Mr. Watson, was somewhat different from that of the Milky Way; for, both being distinctly visible at the same time, the difference was easily detected, that of the zodiacal light being of a yellowish tinge.

Comets' Tails.—In the course of a joint paper presented at the last meeting of the American Association by Professors Hall and Nichols, the authors describe an experiment by which something greatly resembling a comet's tail was obtained under conditions approximating to those of nature. A powder consisting of a mixture of emery powder and puffball spores was placed in a vacuum tube constructed something like an hour-glass. The vacuum was made as perfect as could be obtained, precautions being also used to get rid of mercury vapour. On pouring the powder from one part of the tube to the other, and at the same time concentrating on it the rays from an arc light, the lighter portions of the powder were seen to be blown out as if repelled by the light, and presented an appearance quite similar to that of a comet's tail. The effect was of the same order of magnitude as would be expected from the values Professors Hall and Nichols had obtained from light pressure. They thought the phenomenon might be due in part to other causes; but even if this was true, the experiment reproduced the behaviour of a comet's tail with great accuracy.

The Flash Spectrum.—In a paper communicated to the Royal Society by Mr. J. Evershed, the photographs of spectra obtained during the solar eclipse of 1900 are discussed, and the general correspondence between the flash and Fraunhofer lines noticed in 1898 is confirmed. An explanation of the abnormal intensities of the enhanced lines in the flash spectrum is now offered, which depends on the assumption of a continuous circulation of the solar gases in a radial direction; the highly-heated ascending gases giving the predominant features to the flash spectrum, whilst the cooler more diffused gases slowly subsiding determine the character of the absorption spectrum. The final conclusion is that the flash spectrum represents the emission of both ascending and descending gases, whilst the Fraunhofer spectrum represents the absorption of the descending gases only.

Nova Geminorum.—Concerning this interesting Nova, which was discovered by Professor Turner at Oxford on March 24, Professor Hartmann of Potsdam finds that its visual spectrum shows the hydrogen lines Hβ and Hα very bright; the yellow region is very weak, but the blue contains numerous bright lines, nearly producing the effect of a continuous spectrum. This is confirmed by Newall and Hall, the latter adding that the star is red. Professor E. E. Barnard states that on March 27 the star was of a strong red colour; to Carki it appeared on the same date to be colourless.

A Heidelberg photograph of February 16 shows no trace of the star; the Harvard plates show that it was below the 12th magnitude on March 1, below the 9th on March 2, and the 5th on March 6; further, it was about 7m·5 on March 16, 8m·5 on March 27: so that it seems to be declining rapidly. It is probably a Nova, but may possibly be a variable of the Mica type.

Recently Discovered Terrestrial Gases in the Chromosphere.—Owing to their proved relationship to helium, Professor S. A. Mitchell of Columbia University suspected that the recently discovered gases neon, argon, krypton, and xenon might be found to exist in the chromosphere, and in order to test his supposition he compared the wave-lengths of the lines in their respective spectra with the wave-lengths of the chromospheric spectrum obtained by himself during the Sumatra eclipse.

Owing to the low densities of the new gases, it is to be expected that, as is the case with helium, they will not appear in the normal solar spectrum, even though they may appear in the spectrum of the chromosphere; and again, owing to the low atomic weights of neon and argon, Professor Mitchell expected that these two gases might appear in the spectrum, whilst krypton and xenon, the atomic weights of which are greater, would probably not so appear.

As a result of his comparison, Professor Mitchell comes to the conclusion that lines due to neon and argon are present in the chromospheric spectrum, but the evidence as to the presence of krypton and xenon is at present inconclusive. Lines which are due to the more volatile gases of the earth's atmosphere—that is, those which are uncondensed at the temperature of liquid hydrogen—as published by Liveing and Dewar, appear at $\lambda\lambda$ 4047, 4398, 4422, 4431, 4540, and 4844; and the strongest argon lines—namely, those at $\lambda\lambda$ 4180·3, 4200·8, 4259·5, 4266·8, and 4430·3—are also represented in the spectrum of the chromosphere.

Professor Mitchell suggests that these gases may have come to the earth's atmosphere from the sun, as suggested in the theory put forward by Arrhenius, which supposes that ionised

particles are constantly being repulsed by the pressure of light, and thus journey from one sun to another.

The Rainfall of London, 1858–97.—The following particulars are from the Camden Square station. The average rainfall is 25·46 inches. The driest period is the spring, the rainfall each month from February to May being below two inches; in all other months the average fall exceeds two inches, the maximum, 2·71 inches, occurring in October. The greatest monthly fall was 6·72 inches in August 1878, and the lowest 0·01 inch in February 1891. The greatest daily fall was 3·28 inches on June 23, 1878. Rain falls, on an average, on 161·8 days in the year, the extremes being from 106 to 204 days.

The Earth's Centre of Gravity.—At the last meeting of the Royal Astronomical Society, Mr. Chandler drew attention to the fact that we may have to revise another of our notions concerning the immutability of the earth; its centre of gravity *may* not be fixed, but may oscillate every year to the extent of about five feet. This, or some other explanation, must be found for a curious phenomenon discovered by Mr. Kimura, who is in charge of the station at Misuzawa, Japan, one of the six stations fitted for observing the "variation of latitude." The new phenomenon is in itself a variation of latitude, but of a different nature from that resulting from a movement of the North Pole. If the North Pole comes slightly nearer Japan, so as to *increase* the latitude of Japan, it will be the same amount further away from Europe, and the latitude of Europe will be *decreased*. But the new phenomenon increases or decreases the latitude of both Japan and Europe and all the other stations simultaneously. It is of a totally unexpected kind, and cannot be explained by any cause with which we are at present familiar. A movement of the earth's centre of gravity alternately northwards and southwards along its axis would explain the facts as yet known; but how are we to explain such a movement of the centre of gravity? One possibility will doubtless occur to many readers. We know that masses of snow and ice collect at the North Pole in our winter, and at the South Pole in our summer. Is the transference of this mass from pole to pole sufficient to account for the displacement of the earth's centre of gravity? The answer is, however, clear. Not only is the amount insufficient, but it would have the *opposite effect* from that observed. We must, in fact, acknowledge that we are only on the threshold of the inquiry.—*Illustrated Scientific News.*

A New Comet.—The discovery of a new comet is reported by Mr. John Grigg of Thames, New Zealand, on the 17th of last month. Mr. Grigg detected a small comet in the constellation Virgo on July 22 last year; but bad weather supervened, and no observations were secured at any other observatory. Mr. Grigg has since been more fortunate, as a satisfactory observation of his new discovery was secured by Mr. John Tebbutt, Windsor, New South Wales. He obtained the following position for the new object on April 26·8617, Greenwich mean time:—R.A. 4 h. 3 min. 1·6 sec. Daily motion in R.A. + 5 min. 54 sec. N.P.D. 160° 23′ 25″. Daily motion 27′ south. The comet, therefore, is not visible from these latitudes. It is not far from conjunction with the sun, from which, however, it is apparently slowly receding.

CHEMISTRY.

(ADVANCED AND HONOURS.)

BY T. CARTWRIGHT, B.A., B.SC.

Estimation of the Relative Amounts of Krypton and Xenon in the Air.—Before the Royal Society, on 26th March, Sir William Ramsay read a paper on this subject. In these experiments 191·1 kilograms of gaseous air were passed into a Hampson's liquefier, and 11·3 kilograms of air were liquefied. The liquid air was evaporated in a partial vacuum until only about 200 c.c. remained. The residue, consisting largely of oxygen, and also containing argon, krypton, and xenon, was deprived of oxygen and nitrogen by means of red-hot copper and magnesium lime, and the resulting mixture was fractionated so as to separate the argon, krypton, and xenon. Complete separation was not achieved, but knowing the densities and volumes of the fractions of gas obtained, their relative amounts could be calculated. This method does not preclude loss of the rarer gases, but that loss, especially in the case of xenon, must have been small—the vapour pressure of krypton at the temperature of fractionation, − 195°, being only 2·8 mm., and that of xenon 0·02 mm.

The results are reproduced in the following tabular statements:—

Per cent. of krypton in gaseous air = 0·000014 by weight.
" " xenon " " = 0·0000026 "

Krypton equal to 1 part by weight in about 7 millions of air; by volume, 1 part in 20 millions. Xenon equal to 1 part by weight in about 40 millions of air; by volume, 1 part in 170 millions. As before remarked, it is not maintained that all the krypton and all the xenon have been separated; it is likely, however, that the separation of the xenon was more perfect than that of the krypton.

As a quantity of pure krypton sufficient for determination of density had been collected, occasion was taken to redetermine the density of that gas, with the following result, that the value compared with O = 16 was found to be 40·81. The atomic weight of krypton would, therefore, be 81·62; the mean of former determinations is 81·28. This is in accordance with its position in the periodic table, which lies between bromine 80 and rubidium 85.

Separation of As, Sb, and Sn (Professor James Walker).—The sulphides are dissolved in caustic soda, and the solution is boiled with sodium peroxide. This produces sodium stannate, arsenate, and antimonate. An excess of ammonium chloride is then added, and the liquid is boiled. This treatment precipitates all the tin as stannic hydroxide; and although the precipitate may contain a little antimony, the separation answers for qualitative purposes.

In separating the sulphides under consideration from the sulphides of the copper group by the use of sodium hydroxide, it is necessary to add a few drops of yellow ammonia sulphide in order that stannous sulphide may readily dissolve. It is to be noticed, also, that mercuric sulphide is soluble in this solution, but this is precipitated as such when the other sulphides are oxidised by sodium peroxide.

The presence of tin is confirmed by dissolving the stannic hydroxide in concentrated hydrochloric acid, reducing to stannous chloride by boiling with metallic iron, and testing with mercuric chloride, or also with hydrogen sulphide.

To detect antimony and arsenic, it is recommended to acidify the filtrate from the stannic hydroxide, to warm until oxygen ceases to be evolved, then to cool and pass in a rapid stream of hydrogen sulphide. This treatment precipitates antimonic sulphide, which is filtered off. The resulting filtrate is then treated with a few drops of sodium thiosulphate solution, and warmed until a precipitate begins to form. This may be sulphur alone or arsenious sulphide. The precipitation of arsenic is then made or completed by passing hydrogen sulphide.

Arsenic Pentachloride.—Although phosphorus and antimony pentachloride are well known, all the numerous attempts to prepare the pentachloride of arsenic have hitherto failed. The apparent non-existence of this compound is considered remarkable on account of the intermediate position of arsenic in its relations to phosphorus and antimony. Baskerville and Bennet now believe that they have succeeded in preparing this much-sought compound. They placed arsenic trichloride in a test-tube surrounded by solid carbon dioxide, then led in chlorine. The trichloride, which had solidified at the low temperature used, assumed a greenish-yellow colour, and became liquid, and the liquid increased in bulk since the chlorine was liquified. By allowing the excess of chlorine to distil off at a temperature 2 or 3 degrees above the boiling point of chlorine (− 35·6), a residual liquid was obtained, in one case at least, which had a composition approaching that required for the supposed compound $AsCl_5$. It may be observed that there is very slight evidence here that the liquid was a definite compound, and not a solution of $AsCl_3$ in liquid chlorine, for there is no doubt that the boiling point of chlorine would be raised appreciably by the presence of a large amount of a substance in solution. However, the authors state that the product, after being dissolved in absolute ether at − 31°, gave yellow prisms when the solution was chilled several degrees, and that a special preparation made in a sealed tube formed beautiful yellow crystals at − 38° or − 40°. These facts furnish some evidence, perhaps, of the existence of the pentachloride, but it seems unfortunate that the crystals were not analysed.

The Bunsen Flame of Radium.—F. Geisel has shown that a very small amount of radium bromide gives a characteristic colour to the Bunsen flame. He describes the spectrum as consisting of two red bands and a bright blue line. He also saw feeble lines in the violet. C. Runge and J. Precht have investigated this spectrum with the aid of a Rowland grating and the meter radius. They found the spectral lines very transitory. The line in the blue at wave-length 4826 remained the longest.

It seemed of the same character as the barium line 5536, the strontium line 4607, and the calcium line 4226.

Separation of Nickel and Cobalt.—Dissolve cobalt and nickel sulphides in $KClO_3$ and HCl. Evaporate down to small bulk, and add sodium acetate and potassium nitrite. Allow to stand for six hours. Then cobalt is precipitated as a double nitrite of potassium and cobalt, whilst nickel remains in solution.

The Precipitation of Cupric Chloride and Bromide by Sulphuric Acid (Georges Viard).—*Cupric Chloride.*—Sulphuric acid added in large excess to the solution drives off bubbles of hydrochloric acid, while the mixture becomes very hot; but the amount of chloride decomposed is very slight, and nearly all the dissolved salt is precipitated in the form of brownish-yellow anhydrous chloride. When the sulphuric acid is not in sufficient excess, the green hydrated chloride, $CuCl_2 + 2H_2O$, is precipitated. More than 68·4 per cent. of its weight of sulphuric acid must be added for the anhydrous chloride to be formed. This anhydrous chloride appears as very small yellow crystals under the microscope; by allowing the green solution of $CuCl_2$ in H_2SO_4 to cool slowly, much more voluminous arborescent crystals are deposited. *Cupric Bromide.*—An excess of sulphuric acid precipitates this salt from its solution, but the precipitate always consists of the black anhydrous bromide. The reaction is much more sensitive than with the chloride: a solution of $\frac{1}{1000}$th $CuBr_2$ with an excess of sulphuric acid gave an abundant black precipitate. The difference of solubility of the chloride and the bromide in sulphuric acid furnishes a ready means for distinguishing between these two salts. A mixture of 1 volume of sulphate of copper at $\frac{1}{10}$th with 10 volumes of H_2SO_4 is prepared in advance. By adding to this mixture a few drops of the salt to be tested a precipitate is formed; if yellow it is a chloride, if black it is a bromide. In this manner a solution of KCl at $\frac{1}{1000}$ or of KBr at $\frac{1}{1500}$ can be recognised.

Carborundum.—This most important by-product of the electric furnace rewarded Mr. Acheson, in 1891, for his endeavours to produce diamonds artificially. Carborundum is now manufactured from coke, salt, sawdust, and sand; and it resembles the diamond in three very important respects—it is intensely hard, it is brittle, and it is insoluble in all liquids. It can be used for all purposes where emery has hitherto been employed; but it is as a lining to furnaces where exceedingly high temperatures are in question that this artificial mineral finds its most important *rôle*. Carborundum is absolutely infusible, and a thin layer of it applied in the form of paint to ordinary firebricks will confer upon them a resisting power to the highest temperatures which it is possible to command. The method of adapting carborundum to this service has been studied simultaneously by Mr. Engels of Düsseldorf and Mr. Grant Baillie of Blackheath, London.

The Hydrates $R(OH)_2$ (F. F. Sélivanof).—The author, having observed that freshly precipitated HgO is soluble in a solution of acetamide, but that it is no longer so some time after precipitation, was induced to examine the different metallic hydrates from the point of view of their solubility. The peculiarity shown by HgO may be explained by admitting that $Hg(OH)_2$ is formed first, and that this substance is then transformed into the insoluble HgO; but there are numerous hydrates insoluble in water, but which dissolve in solutions of sugar, glycerine, etc., provided they are in contact with these solutions at the moment of their precipitation. For this reaction it is much more difficult to find an explanation. $Cu(OH)_2$ and $Zn(OH)_2$ are soluble in relatively small quantities of a solution of NH_3, but the solutions may be strongly concentrated over CaO or KOH without a precipitate being formed; finally, $Cu(OH)_2$ gives crystals of $CuO.4NH_3.H_2O$. The existence of this already known compound gives rise to the supposition that copper forms hydrates more hydrated than $Cu(OH)_2$. These higher hydrates are known in the case of many metals, such as Ba, Sr, Ca, Zn, etc. The hydrates $R(OA)_2$ may unite, not only with H_2O, but also with other bases, such as the alkalis; which allows of the supposition that they are able to combine with themselves, forming polymers $[R(OH)_2]n$. The insoluble hydrates appear to be polymers of this description; this hypothesis finds a basis in the constitution and properties of the basic salts, especially the salts basic to two bases like those which have been produced recently by Mailhe and by Recoura.

Affinity at Low Temperatures: Reaction of Liquid Fluorine at − 187° (H. Moissan and J. Dewar).—The affinity of liquid fluorine at a temperature of − 187° is powerful enough to ignite sulphur, selenium, phosphorus, and arsenic without the aid of any external energy. It violently decomposes calcium oxide, and with anthracene forms an explosive mixture. Such experiments show that, at very low temperatures, the force of affinity acts strongly in reactions as energetic as those between fluorine and certain simple or compound bodies.

THEORETICAL MECHANICS.

(ADVANCED AND HONOURS STAGES.)

BY FRANK CASTLE, M.I.M.E.,

Royal College of Science; Lecturer on Mechanics, Geometry, etc., Morley College, London; Author of "Elementary Practical Physics," "Practical Mathematics," etc.

It is only necessary in this concluding series of "Notes" to suggest that the opportunity, before the commencement of another session, may be taken to obtain some practice in numerical exercise work. This may and should be carried on simultaneously with the reading of the various sections. Suitable exercises may be obtained from previous issues of the *Practical Teacher*. These are chiefly taken from examination papers, and are therefore about the requisite degree of difficulty. Those students who intend to take up the Honours stages will find it advisable to read up more particularly those portions of the subject in which the calculus is required. The proofs of formulæ, etc., are, as a rule, too long for insertion in these columns, and reference must be made to books dealing with the subject.

The attention of the reader has from time to time been drawn to some of the more important sections in "Solids" and "Fluids." The present is probably a fitting opportunity to consider a few of the remaining sections.

Metacentre.—Of the remaining sections in Fluids, it may be desirable to consider briefly the conditions of equilibrium of a floating body, and more particularly what is meant by the metacentre of such a body. Usually the calculus is required, but the position in simple cases can be obtained by elementary methods when the moment of inertia of the body (which may in the usual manner be denoted by I) is known. The value of I can be obtained from tables, or, better, by calculation. When I is known, then *k, the radius of gyration*, may be obtained by means of the relation $I = Mk^2$, where M denotes the mass of the body.

In many cases, especially when the body is of a simple form—that is, a cube, cylinder, etc.—the value of I can be readily calculated by the aid of the most elementary notions of the calculus. Thus, in the case of a circular lamina of radius r, we may consider an indefinitely thin annulus at a distance x from the axis, and of thickness dx. The area of such a ring will obviously be its length $2\pi x$, multiplied by its thickness dx.

Taking unit distance perpendicular to the plane of the diagram, then, if m denotes the mass of unit volume of the material, the moment of inertia of such a ring is, by definition, the product of the mass, and the square of its distance from the axis. Hence moment of inertia of such a ring is

$$m \times 2\pi x dx \times x^2 = 2\pi m x^3 dx.$$

To obtain the moment of inertia of the lamina, we may assume the body to be divided into an indefinitely large number of such rings, starting from the axis, where $x = 0$, to the circumference, where $x = r$. The sum of all such terms is indicated in the usual manner by prefixing the sign of integration.

$$\therefore I = \int_0^r 2\pi m x^3 dx = \frac{2\pi m r^4}{4}.$$

If M denotes the total mass of the lamina, then

$$M = m \times \pi r^2.$$

$$\therefore I = \frac{Mr^2}{2}.$$

This gives the moment of inertia about an axis passing through the centre of the lamina, and perpendicular to its plane. In dealing with problems on the metacentre, the moment of inertia about a diameter is required. This is one-half the preceding, or

$$\frac{Mr^2}{4}.$$

If k denotes radius of gyration, then from the relation

$$Mk^2 = \frac{Mr^2}{4}, \quad k = \frac{r}{2}.$$

The formula for the position of the metacentre is given by

$$HM = \frac{Ak^2}{V}. \quad \ldots\ldots\ldots \quad (1)$$

This gives the height of the metacentre in terms of H, the centre

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of buoyancy in the equilibrium position; V, the volume displaced; and A, the area of the horizontal section of body at the surface of the liquid. If C is the centre of gravity of a floating body, then the equilibrium is stable, if C lies below M. ∴ if HM > HC.

The equilibrium is neutral when M and C coincide, and is unstable when M is below C.

The formula (1) may be expressed in a simpler form in the case of a solid such as a cylinder of radius r and height h.

A denotes the area of cross-section when the cylinder floats in an upright position. ∴ $A = \pi r^2$.

V, the volume immersed, is $\pi r^2 hs$, where s denotes the specific gravity of the liquid.

Substituting these values in (1), we obtain—

$$HM = \frac{\pi r^2 \times \frac{r^2}{4}}{\pi r^2 hs} = \frac{r^2}{4hs}.$$

$$\therefore 4HMhs = r^2.$$

It will be noticed that for a cylinder of given height and material, floating with its axis vertical, the greater the radius the greater the stability.

Ex. 1. The formula for the determination of the metacentre being $HMV = AI^2$, state the meaning of each term of the formula.

Given that the moment of inertia of a circular lamina about a diameter is $Mr^2 \div 4$, find the relation between the length and diameter of a cylinder of cork when it floats with its axis vertical, the specific gravity of cork being 0·25. (1893.)

The cylinder will float with 0·25 of its length immersed. Hence H will be $\frac{1}{8}h$, where h denotes the height or length of the cylinder, the distance H being measured from the base of the cylinder.

The distance between H and C will be

$$\frac{h}{2} - \frac{h}{8} = \frac{3}{8}h.$$

The equilibrium is stable if C lies below M. ∴ if HM > HC.

Substituting in the formula, we obtain

$$4HMh \times 0{\cdot}25 = r^2.$$

$$\therefore HM = \frac{r^2}{h}.$$

Also, since HM is to be greater than HC,

$$\frac{r^2}{h} > \frac{3}{8}h, \text{ or } r^2 > \frac{3}{8}h^2.$$

As $r = \frac{d}{2}$, we obtain by substitution $d^2 > \frac{3}{2}h^2$. Or, remembering that the least height of the cylinder occurs when H coincides with C, we obtain for the least height the relation

$$r^2 = \frac{3}{8}h^2, \text{ or } d^2 = \frac{3}{2}h^2.$$

Ex. 2. Given the formula for the metacentre of a cylinder floating with its axis vertical—namely, $4HM \times hs = r^2$—state the meaning of the parts of the formula.

A cylinder (sp. gr. 0·7) has a radius of 7 in. Find the greatest height it can have if it is to float with its axis vertical in still water. ($\sqrt{42} = 6{\cdot}48$.) (1894.)

The cylinder will float with $\frac{7}{10}$ of its length immersed; hence the position of H, the centre of buoyancy, will be $\frac{7}{20}h$, measured from the base of the cylinder. The distance between H and C will be $\frac{h}{2} - \frac{7}{20}h = \frac{3}{20}h$.

The equilibrium is stable if C lies below M. ∴ if HM > HC.

Substituting in the formula, we obtain

$$4HM \times \tfrac{7}{10}h = r^2 = 49.$$

$$\therefore HM = \frac{49 \times 10}{4 \times 7 \times h} = \frac{35}{2h}.$$

Hence, since HM is to be greater than HC,

$$\frac{35}{2h} > \frac{3}{20}h, \text{ or } h^2 < \frac{25 \times 42}{9}.$$

$$\therefore \text{if } h < \frac{5 \times \sqrt{42}}{3}.$$

Substituting the given value of $\sqrt{42}$, $h < 10{\cdot}8$. Thus the height of the cylinder must not exceed 10·8 inches.

Ex. 3. Assuming the formula $HMV = AI^2$, find the metacentre of a cube (specific gravity s) floating, with four of its edges vertical, which receives a small displacement round an axis drawn through the middle points of two opposite sides of the square in the plane of flotation.

Under what circumstances would the equilibrium be stable with reference to such a displacement? (1897.)

Let a denote the length of one of the edges of the cube; then A, the area of a face, is a^2. The volume immersed is given by $V = sa^3$, where s denotes the specific gravity of the material.

$$\text{Also, } I^2 = \frac{a^2}{12}.$$

$$\therefore HM = \frac{a^2 \times \frac{a^2}{12}}{sa^3} = \frac{a^2}{12s}.$$

The distance between H and C or HC will be

$$\frac{a}{2} - as = \frac{a - 2as}{2}.$$

The equilibrium is stable if C lies below M. ∴ if HM > HC.

Substituting, $\frac{a^2}{12s} > \frac{a - 2as}{2}$. ∴ if $a^2 > 6(a - s)s$.

Ex. 4. Write down and explain briefly the formula which determines the stability or instability of a floating body.

A solid right circular cone is built on the base of a solid hemisphere, and is of the same homogeneous material. If its specific gravity be such that it can float with the curved surface (wholly or in part) only in contact with the liquid, find the limiting ratio of the height of the cone to the radius that the equilibrium may be stable. (1901.)

Ex. 5. The diameter of a cylinder of uniform density equals its height. Find between what limits its specific gravity must be if it is in unstable equilibrium when floating in still water with its axis vertical. (1898.)

Ex. 6. Define the metacentre of a floating body, and show that the equilibrium is stable when the metacentre is above the centre of gravity.

A cubical box is made of six square plates of a material whose specific gravity is 8. It floats with one-sixth of a vertical edge in the water. Show that the thickness of the plates is very nearly 1·288th part of the length of an edge. Show also that in this position it will float in stable equilibrium. (1901.)

Ex. 7. Assuming the formula for the metacentre of a floating body, show that for a cylinder of given height and material, floating with its axis vertical, the greater the radius the greater the stability. (1895.)

ELECTRICITY AND MAGNETISM.

(ADVANCED AND HONOURS STAGES.)

BY EDWIN EDSER, A.R.C.S., F.PH.S.

It is proposed in the present article to give a brief *résumé* of the most important laws and definitions in connection with voltaic electricity. If these are carefully remembered, many otherwise difficult problems will be found to admit of easy solution.

Measurement of Current.—The electric current is measured in terms of the magnetic field produced at a given distance from the conductor carrying the current. The positive direction of the current, in a circuit comprising a Daniell's cell, is that from the copper (or +) electrode to the zinc (or −) electrode. Since a reversal of the direction of the current, in a given conductor, reverses the direction of the magnetic field at every point within a finite distance from the conductor, we can easily settle the direction in which the current flows in any particular case. The *unit current* is thus defined: If unit current flows along a wire bent into a circle of 1 cm. radius, then there must be a magnetic field, of which the strength is equal to 2π dynes per unit pole, at the centre of the circle. Now, let an unknown current, of C units, flow along a wire bent into a circle of radius r cms. The field at the centre of the circle is—

(1) Directly proportional to the current;
(2) Directly proportional to the length of the circular conducting path;
(3) Inversely proportional to the square of the radius of the conducting path.

Thus, since the length of the circumference of a circle is proportional to the radius, the field f, at the centre of the circle into which the conductor is bent, is given by the equation—

$$f = 2\pi \times C \times r \times \frac{1}{r^2} = \frac{2\pi C}{r}.$$

$$\therefore C = \frac{rf}{2\pi}.$$

This gives us a method of measuring an electric current in terms of the field at the centre of a circular conducting circuit

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in which the current flows. An instrument which may be used to measure a current in this manner is the tangent galvanometer.

The unit current, as defined above, is termed the C.G.S. unit current. The practical unit, the ampère, is only of one-tenth the magnitude of the C.G.S. unit. Consequently, to convert a current measured in C.G.S. units into ampères, we must multiply by ten; conversely, to convert ampères into C.G.S. units, we must divide by ten. It should be noticed that in effecting this measurement, it is not necessary to assume that anything actually flows along the wire in the direction we have defined as positive; nevertheless, it is convenient, to avoid circumlocution, to speak of the flow of the current as if something actually did flow along the conductor.

Difference of Potential.—The flow of the electric current is intimately connected with energy transformations. Thus, in an ordinary conductor traversed by an electric current heat is generated. By the law of conservation of energy, this heat must have been produced at the expense of an equivalent amount of energy which has disappeared from the electric circuit. In this case electric energy is converted into heat. It should be noticed that, if the direction of the current is reversed, its magnitude remaining constant, the same amount of heat as before is produced. Hence this constitutes an *irreversible energy transformation*. When the terminals of a Daniell's cell are joined by means of a wire, a current flows through the latter. Chemical reactions also occur in the cell: the zinc dissolves from the negative electrode, forming $ZnSO_4$; while copper is deposited on the positive electrode from the surrounding $CuSO_4$ solution. Further, the zinc dissolved in a given time liberates more energy than is required to deposit the copper removed from solution in this time, the excess of energy liberated being converted into electrical energy. If we now, by means of other cells introduced into the circuit, reverse the direction of the current passing through the Daniell's cell, we reverse the nature of the energy transformation. Copper is now dissolved from the positive electrode, and zinc is deposited on the negative electrode; the energy liberated in a given time by the solution of the copper is less than that required to remove from solution the zinc which has been deposited in that time, the deficit being supplied from the electric circuit. Here, then, we clearly have a *reversible energy transformation*.

We are now in a position to appreciate the definition of a potential difference between two points in an electric circuit. *If any energy transformation occurs between two points in an electric circuit, then there is a difference of potential between those points.* When between the points in question energy is removed from the electric circuit, the potential is said to fall in the direction of the current; when energy is introduced into the circuit between the points in question, the potential is said to rise in the direction of the current. Thus, since an electric current always heats a conductor through which it flows, energy is removed from the electric circuit and converted into heat, and a fall of potential occurs in the direction of the current. When an electric current flows through a Daniell's cell, there will be a rise of potential in the direction of the current, if the latter flows from zinc to copper through the cell; in other words, the copper terminal will be at a higher potential than the zinc. If the current flows through the cell from copper to zinc, a fall of potential will occur in the direction of the current, so that once more the copper is at a higher potential than the zinc. When the energy transformation between two points in a circuit is completely reversible, the change of potential which occurs between those points is said to constitute an *electro-motive force* (E.M.F.). The E.M.F. will be direct or positive (that is, in the direction of the current) if energy is introduced into the circuit; in the alternative case, the E.M.F. is said to be back or negative. When the energy transformation between two points in a circuit is wholly or partially irreversible, we merely speak of the potential difference (P.D.) between those points. P.D.'s and E.M.F.'s are measured in the same units.

Let W be the energy in ergs, which is added to or subtracted from the electric circuit between two given points, in a time t. Let C be the current in C.G.S. units flowing between these points. Then *the* P.D. *between the points is defined as the energy transformed per unit current per unit time.* Thus, if the P.D. is equal to V, we have the equation

$$V = \frac{W}{Ct} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

This equation shows that for a P.D. of one C.G.S. unit to exist between two points in a circuit we must have a transformation of 1 erg per second for each C.G.S. unit of current. This unit has been found to be too small for practical service. The practical unit of P.D., termed the volt, is equal to 10^8 C.G.S. units of P.D. Thus, for a P.D. of 1 volt to exist between two points in a circuit, there must be a transformation of 10^8 ergs per second for each C.G.S. unit of current, or 10^7 ergs per second for each ampère.

From (1) we have

$$W = CVt$$

if C and V are measured in C.G.S. units. If C and V are respectively measured in ampères and volts, then W, the energy in ergs transformed in a time t, is given by the equation

$$W = CVt \times 10^7. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

$$\therefore \frac{W}{t} = CV \times 10^7.$$

Now $\frac{W}{t}$ is equal to the *energy transformed per second*, or the *power* expended (or generated) between the given points of the circuit. Thus, if one ampère flows between two points differing in potential by one volt, the power expended (or generated) between those points is equal to 10^7 ergs per second. This constitutes the practical unit of power, and is termed the *watt*. Thus, if we multiply the P.D., in volts, between two points of a circuit, by the current in ampères flowing between those points, we at once obtain the power in watts expended or generated between those points.

It should be noticed that, presuming we are in a position to make accurate measurements of current, energy, and time, the P.D. between two points in a circuit becomes immediately determinable. The equation

$$W = CVt$$

does not express any experimental law, but is derived from the definition of the potential difference V.

Resistance.—As already explained, the irreversible heating effects of an electric current show that, between any two points of a conductor along which an electric current is flowing, there must be a fall of potential in the direction of the current. The heat produced in a given time may be measured calorimetrically, when, from the results obtained by Joule, the energy transformed into heat in that time may be calculated. Then, from the fundamental equation (1) above, the value of the P.D. between the ends of the conductor can be determined, if the current is measured by means of a tangent galvanometer or other similar instrument.

Let us suppose that we keep the conductor at a constant temperature while we perform a number of experimental determinations of V for various values of C. Then we are in a position to determine in what manner V depends on C. The result of such a determination is termed Ohm's law, and is as follows:—

When an electric current flows along a metallic conductor which is maintained at a constant temperature, the P.D. *between the ends of the conductor is proportional to the current.*

In symbols, Ohm's law may be expressed by the equation

$$V = RC. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

where R is a constant. The value of this constant is termed the *resistance* of the conductor.

If V and C are measured in C.G.S. units, R will be given also in C.G.S. units. Thus *a conductor will have unit* C.G.S. *resistance, if one* C.G.S. *unit of current flowing along it establishes unit* C.G.S. *difference of potential between its terminals.* The practical unit of resistance is the ohm; this is the resistance of a conductor which, when carrying one ampère, has a difference of potential of one volt between its terminals. Since

$$R = \frac{V}{C},$$

and one volt = 10^8 C.G.S. units of P.D., while one ampère = 10^{-1} C.G.S. units of current, we see that one ohm is equal to $10^8 \div 10^{-1} = 10^9$ C.G.S. units of resistance.

Equation (3) involves three quantities, any one of which becomes known when the remaining two have been determined. Expressing V in terms of C and R, and substituting in (2), we obtain

$$W = C^2Rt,$$

which determines the energy transformed into heat, in terms of the current, the resistance, and the time.

Expressing C in terms of V and R from (3), and substituting in (2), we obtain

$$W = \frac{V^2t}{R},$$

which determines the energy transformed into heat, in terms of the P.D. between the ends of the conductor, the resistance, and the time.

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RESULT OF THE APRIL COMPETITION.

The prize is awarded to "Ecila." (Will the prize-winner kindly forward name and address for publication?)

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Report.

The faults this month are mainly faults of English construction rather than absolute errors in the translation of the French. For instance, the change from *on* in the fourth line to *vous* in the fifth line led to many renderings which laid themselves open to criticism. Lower down there is a similar change, which also proved a trap. A large number, again, translated *ses yeux sont louches* by "he squints," and yet translated *les* in *les a placés* by "them," quite forgetting that their pronoun had no antecedent. Beyond such faults as these, there are very few general weaknesses.

The prize-winner of the March competition ("Gentiane") was L. M. Wilkes, 283 Friern Road, E. Dulwich, London, S.E.

Prize Translation.

I have never understood the nicety which allows one to exclaim, "What a fine horse!" "What a lovely rose!" and yet strictly forbids the same remark to be made about one's face (which, however, was no more the result of personal labour than these) simply because it happens to be one's own. To hear some one speak of his nose, or declare that he squints, is allowable, and is even rather relished. But to foolishly avow that the good God has placed one's eyes correctly—is dreadful! It is a thing of which any one ought to be wholly ignorant, as though the tiniest mirror or the smallest spring did not teach it to us without the slightest aid from any person! One leans over the edge, looks, and sees a pleasing face……Is this a crime, and ought we to trouble the water that its ripples may distort the features? The deer and the hinds which came to drink this summer, whilst I was silently day-dreaming near them, acted thus. Having finished, they stayed a moment longer with heads bowed, their soft eyes fixed on their reflection. Then they bounded away, artlessly happy in the knowledge that their colour was of so charming a brown, and that their great horns were so well set. After the hinds I leaned over, and saw all that they had seen, on the same blue depths, with the same broken clouds fleeting in white or gray masses; and when I went away afterwards, leaping for joy, like them, neither was it unpleasant to me to think of my appearance.

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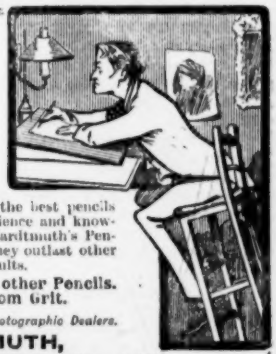

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Co-Education: A Series of Essays by Various Authors. Edited by Alice Woods; with an introduction by Michael E. Sadler. Here we have nine papers dealing with the subject of co-education, or the education of boys and girls at the same schools and in the same classes, without any difference being made on the ground of sex more than is made in ordinary family life in the home. All the writers have had more or less experience, as teachers, of such education, and all are unanimous in favour of the plan. As the work is professedly missionary in its aim, there is no attempt to give the opinions of those who have tried the experiment and regard it as a failure, if there be any such. Mr. Sadler alone, in his introduction, professes himself as not quite convinced, but only "impressed." His opinion, with which we are in complete agreement, is that co-education is natural and right up to the age at which nature has made a distinct difference between boy and girl, but no farther. We should add to this that not only should the sexes be educated apart after that time, but that they should be educated on a totally different plan, and that the curriculum of girls' schools should not be by any means a mere imitation of that of boys' schools, as it too often is. The curriculum in each case should be based on what we know of the nature of the pupil, and not on any tradition of scholasticism, much less of monasticism. To ignore natural differences is as unwise as to assume differences which do not exist, and the apostles of co-education must beware of zeal which is not according to knowledge. The case for co-education up to the age of, say, thirteen is unanswerable, and has been established long ago, and to one who was partly educated on the "new" plan, and who taught many years ago in schools of the "mixed" type, it seems rather odd to regard the plan as yet in the experimental stage; it is an excellent example

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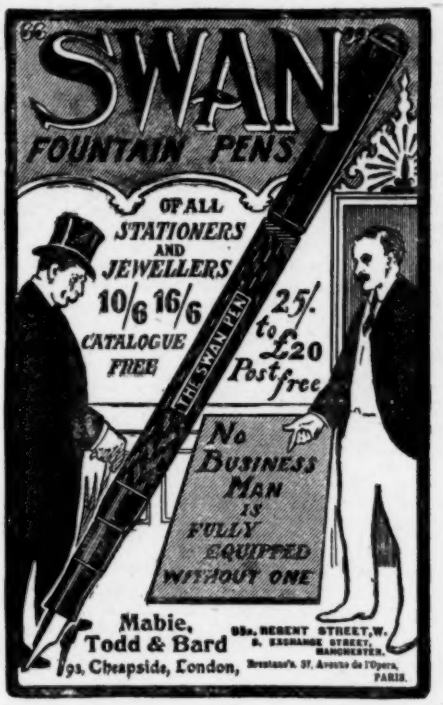

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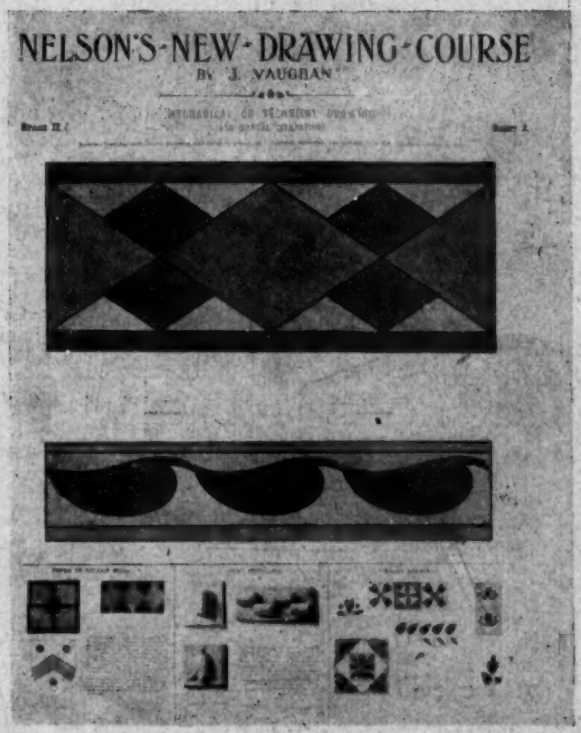

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